August 18, 2022 Railroad Investigation Report RIR-22/13

CSX Transportation Derailment with Hazardous Materials Release and Fire

Draffin, Kentucky
February 13, 2020

Abstract: This report discusses the February 13, 2020, derailment of a high hazard flammable train carrying denatured ethanol while operating on a railroad track between a hillside and the Russell Fork River near Draffin, Kentucky. In the 2 weeks before the derailment, the area where the derailment occurred received more than 300 percent of its normal amount of rainfall, which prompted a mudslide that covered the track with mud and debris immediately before the derailment. Three leading locomotives, a buffer car, and four tank cars derailed, releasing 38,400 gallons of denatured ethanol, which combined with diesel fuel from the locomotives and ignited. The safety issues identified in this report are the high-risk placement of US Department of Transportation-111 tank cars and the influence of weather conditions on railroad operations. Two recommendations are made to the Class I Railroads and Amtrak, and one recommendation is made to the American Short Line and Regional Railroad Association and the American Public Transportation Association.

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Acronyms and Abbreviations

AAR	Association of American Railroads
ASLRRA	American Short Line and Regional Railroad Association
CFR	*Code of Federal Regulations*
CSX	CSX Transportation
DOT	US Department of Transportation
DOT-111	US Department of Transportation -111
FAST Act	Fixing America's Surface Transportation Act
FRA	Federal Railroad Administration
HHFT	high hazard flammable train
MWL	Most Wanted List of Transportation Safety Improvements
NTSB	National Transportation Safety Board
PHMSA	Pipeline and Hazardous Materials Safety Administration
RFA	Renewable Fuels Association
Volpe	John A. Volpe National Transportation Systems Center

Executive Summary

What Happened

On February 13, 2020, a high hazard flammable train carrying denatured ethanol derailed on a CSX Transportation (CSX) railroad track that runs between a hillside and the Russell Fork River near Draffin, Kentucky. In the 2 weeks before the derailment, the area where the derailment occurred received more than 300 percent of its normal amount of rainfall, which prompted the mudslide that covered the track with mud and debris immediately before the derailment. Three leading locomotives, a buffer car, and four tank cars located at the front of the train derailed. Two of the derailed tank cars breached and released 38,400 gallons of denatured ethanol, which combined with diesel fuel from the locomotives and ignited. The locomotives were destroyed by the ensuing fire, and the train crew was able to evacuate through the river and sustained minor injuries.

What We Found

The derailment occurred because the area near the derailment site was subjected to unusually high rainfall amounts in the weeks before the derailment, creating an environment favorable for mudslides to occur across the region. This excessive accumulation of precipitation, combined with a natural drainage environment and the slope of the hill, caused the mudslide.

In addition, we found that although the engineer initiated emergency braking at the first opportunity, there was not enough time to stop the train before it collided with the mudslide. Additionally, we found that the severity of the derailment could have been reduced had the two breached US Department of Transportation-111 tank cars been located further toward the rear of the train where they would have had a lower risk for derailment or damage. These issues were discussed in a 2020 Safety Recommendation Report, *Placement of DOT-111 Tank Cars in High Hazard Flammable Trains and the Use of Buffer Cars for the Protection of Train Crews*.

Furthermore, we found that the system providing weather alerts to the railroad did not consider the above-normal rainfall accumulated over several weeks, and elevated temperatures in the month before the derailment.

We determined that the probable cause of the February 13, 2020, derailment of CSX Transportation train K42911 was loose mud, vegetation, sand, soil, and rock from a mudslide that obstructed the track following excessive rain accumulation over several weeks. Contributing to the derailment was CSX Transportation's use of a weather alert system in which notifications were developed and implemented that did not account for the impact of the unusual increases and accumulation of precipitation. Contributing to the severity of the derailment was a fire resulting from the release of hazardous materials from breached US Department of Transportation-111 tank cars damaged in the derailment. Also contributing to the severity of the derailment was the failure of the Pipeline and Hazardous Materials Safety Administration to withdraw regulatory interpretation 06-0278 that pertains to Title 49 *Code of Federal Regulations* 174.85, which allowed the use of a single buffer railcar between the locomotives and the first tank car containing hazardous materials if no other nonhazardous materials cars are available in the consist.

What We Recommended

As a result of this investigation, we recommended to Amtrak and the Class I railroads that they revise the weather alert criteria for train operators to include recent and long-term historical weather data (dynamic weather conditions) to improve weather alerts. We also recommended that once the criteria are updated, that the railroads ensure their operational and engineering personnel are aware of any revisions and changes to their practices and protocols.

We also recommended to two railroad industry organizations that they notify their members on the circumstances of this derailment and that they request their members review and revise as necessary their weather alert criteria to include input from recent and long-term historical weather data.

As part of this investigation, we previously issued Safety Recommendation R-20-27 to the Association of American Railroads, the American Short Line and Regional Railroad Association, and the Renewable Fuels Association. This Safety Recommendation is classified "Closed—Acceptable Action" for the American Short Line and Regional Railroad Association and the Renewable Fuels Association and "Open—Unacceptable Response" for the Association of American Railroads. We also reiterated Safety Recommendations R-17-1 and -2 to the Pipeline and Hazardous Materials Safety Administration. Safety Recommendation R-17-1 is classified "Open—Acceptable Response" and Safety Recommendation R-17-2 is classified "Open—Unacceptable Response." In addition, we reiterated Safety Recommendation R-17-3 to the Federal Railroad Administration. This Safety Recommendation is classified "Open—Acceptable Response."

1. Factual Information

1.1 Derailment Description

On February 13, 2020, at 6:46 a.m. local time, CSX Transportation (CSX) freight train K42911, a high hazard flammable train (HHFT) carrying denatured ethanol, derailed in Draffin, Kentucky.[1] (See figure 1.) The derailment occurred at milepost 123.8 of the CSX Kingsport Subdivision, on track between a hillside and the Russell Fork River. In the 2 weeks before the derailment, the area had received a substantial amount of precipitation, which resulted in a mudslide immediately before the derailment that covered the tracks with a mass of loose mud, vegetation, sand, soil, and rock. As a result of the derailment, the engineer and the conductor sustained minor injuries. The train, consisting of 3 lead locomotives, 1 front-end buffer car, 96 loaded tank cars, and 1 rear-end buffer car, was 6,045 feet-long and weighed 13,172 trailing tons. All three locomotives, the front-end buffer car, and four loaded tank cars at the front end of the train derailed.

The lead locomotive was partially submerged in the river and the crew evacuated into the river. Two of the derailed tank cars, which were in positions three and four of the consist, were US Department of Transportation (DOT)-111 (DOT-111) tank cars and breached and released 38,400 gallons of denatured ethanol.[2] The ethanol, combined with the 11,300 gallons of diesel fuel, released from the locomotives, ignited, and caught fire, engulfing and destroying the locomotives and the third and fourth cars, which were tank cars. At the time of the accident, the temperature was 55°F with moderate rain and a wind speed of about 6 mph.

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[1] (a) The CSX dispatcher was first notified of the derailment at 6:54 a.m. That was the time initially believed to be the time of derailment. The time of derailment was later adjusted to 6:46 a.m. (b) A *high hazard flammable train* (HHFT) is defined in Title 49 *Code of Federal Regulations* (*CFR*) 171.8 as a single train transporting 70 or more loaded tank cars containing Class 3 flammable liquid. (c) Visit ntsb.gov to find additional information in the public docket for this NTSB accident investigation (case number RRD20FR002). Use the CAROL Query to search safety recommendations and investigations.

[2] *DOT-111 tank cars* are older tank cars built to specifications that are no longer authorized for manufacture in flammable liquids service, but which are permitted to continue in service for specified commodity-based time periods, as required by the Fixing America's Surface Transportation (FAST) Act. For tank cars in ethanol service, the FAST Act phase-out for jacketed and nonjacketed DOT-111 tank cars is May 1, 2023. *Jacketed* tank cars have an outer steel cover that is part of a thermal protection system for the tank shell, which provides additional puncture resistance. *Nonjacketed* tank cars do not have this feature. By the specified compliance date, the tank car must be either removed from flammable liquids service or retrofitted with prescribed protective features, such as a head shield, jacket, and thermal protection. The placement of these tank cars was discussed in detail in the NTSB Safety Recommendation Report, *Placement of DOT-111 Tank Cars in High Hazard Flammable Trains and the Use of Buffer Cars for the Protection of Train Crews* RSR-20/01 (NTSB 2020).

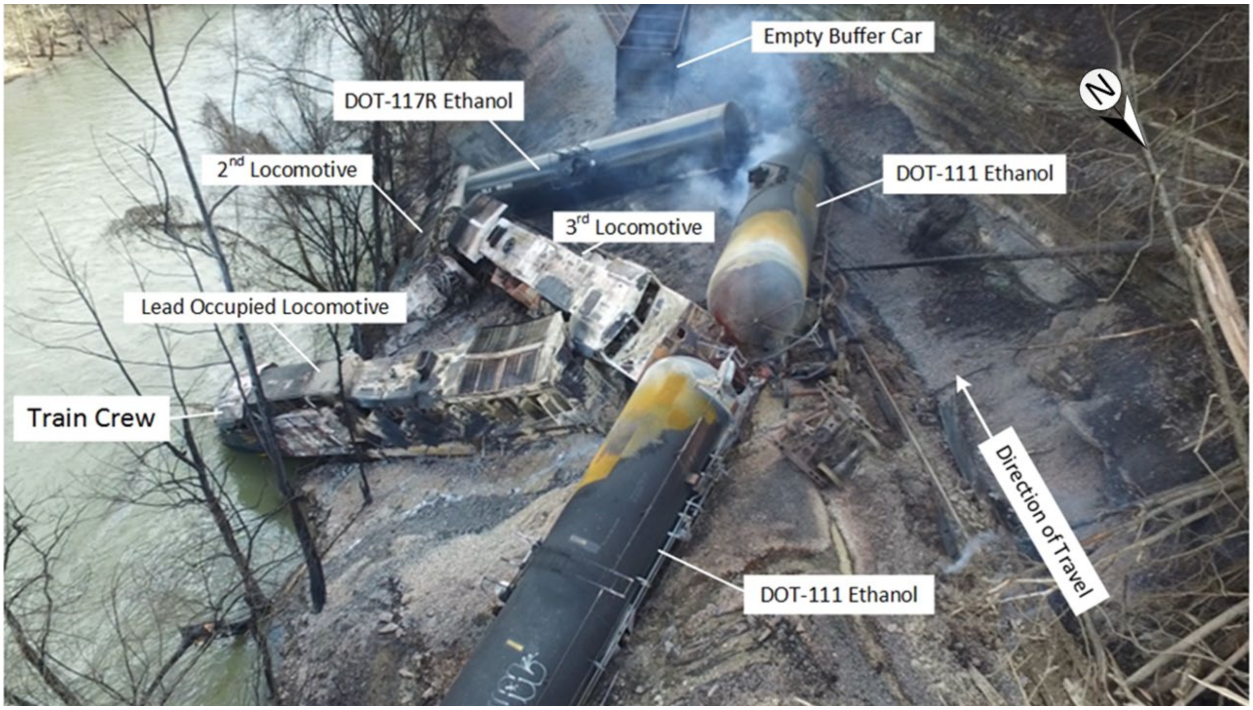

Figure 1. Derailment scene. (Photograph courtesy of Pike County Office of Emergency Management with overlay annotations by the National Transportation Safety Board.)

In an interview with the National Transportation Safety Board (NTSB), the engineer said that the debris from the mudslide was about as high as the nose of the lead locomotive, which would have been about 10 feet high. He stated that he was able to activate the train's emergency brake before the derailment, the sight distance ahead of the train had been about five car lengths due to rain, fog, curves, and darkness.[3] According to wireless uploads from the train's trip optimizer, the train had been traveling between 24 and 25 mph, which was within the authorized speed limit for the tracks.[4] Figure 2 shows the derailment scene and the mudslide.

[3] Although the lengths of cars vary, the average is about 60 feet.

[4] (a) A *trip optimizer*, which may also be known as the train's energy management system, is an intelligent automated locomotive control installed on locomotives that considers terrain, train consist, speed restrictions, and operating conditions to calculate an optimum speed profile. It then automatically controls locomotive throttle and dynamic brakes to reduce fuel burn and provide efficient train handling. (b) The maximum authorized speed for this segment of track was 25 mph.

Figure 2. View of the derailed cars and the mudslide.

The train derailed toward the rain-swollen Russell Fork River, remaining upright with the cab of the lead locomotive partially submerged. (See figure 3.)

Figure 3. Derailed locomotives and ethanol tank car, as viewed from the north.

Smoke and heat from the subsequent fire prompted the engineer and conductor to evacuate the lead locomotive through the front door onto the walkway platform. However, flames from the fire eventually engulfed both sides of the locomotive and trapped the engineer and conductor on the platform facing the rapidly flowing river. At 8:04 a.m., about an hour after the derailment, the crewmembers evacuated the train after a railroad official persuaded them to step from the locomotive platform into the chest-deep water. A swift-water rescue team from the Millard (Kentucky) Fire Department then extracted the crewmembers from the river. Both crewmembers were transported by ambulance to a local hospital for treatment of nonlife-threatening injuries and were later released.

There were no public injuries; however, around 7:30 a.m., local police advised residents of nearby homes to evacuate the area as a precaution over concern about the possibility of intensified fires or possible explosions of the other tank cars. The evacuation advisory was lifted by 10:30 a.m. CSX restored train service on the subdivision 8 days later, on February 21, 2020.

1.2 Events Before the Derailment

The crew of train K42911 consisted of an engineer and a conductor. They went on duty at 12:50 a.m. on February 13, 2020, at Kingsport, Tennessee, the home terminal for both crewmembers.

After reporting for duty, the train crew was transported from Kingsport, Tennessee, to Shelbiana, Kentucky, to take charge of their assigned train, K42911, arriving about 2:30 a.m.[5] At that time, the engineer was notified by the yardmaster that train K42911 was delayed because another train was stopped ahead for fallen trees on the main track. While waiting, the engineer and conductor reviewed two bulletins that were issued for the Kingsport Subdivision (where they would be traveling) that required their attention. One bulletin advised to be on the lookout for a mudslide between milepost locations 120.8 and 120.9. The other advised of an out-of-service slide detection fence, cautioning crews to approach at restricted speed and watch for any obstructions.[6]

After completing the Federal Railroad Administration (FRA)-required safety inspections of the locomotives and the required Class I air brake inspections of the train, the train departed Shelbiana, Kentucky, at 6:04 a.m. with the trip optimizer engaged.[7] According to data from the train's trip optimizer, to comply with the train operations bulletins that were issued before the start of the trip, the throttle was reduced to notch 1 at 6:34 a.m., and the train speed began to slow from about 12 mph to about 5 mph. About 6:37 a.m., the throttle was moved to position 2 and continued to change position up until the time of the derailment. By 6:43 a.m., the train had increased its speed to about 24 mph; at 6:46 a.m., it struck the mudslide and derailed.

1.3 CSX Operations and Weather Alert Criteria

CSX authorizes train movements on the Kingsport Subdivision with signal indications as part of a traffic control system. Train movements are coordinated by a train dispatcher located at the CSX Dispatch Center in Jacksonville, Florida.

CSX contracts with a weather service provider to send weather alerts to dispatchers based on criteria developed by the contractor and the railroad. The weather alert criteria were static, meaning they only considered the current weather and near-term forecast; they did not consider unusual weather conditions over the

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[5] Train crews are often transported to their assigned train when they report for duty by contracted taxi or shuttle services.

[6] *Slide detection fences* are interconnected with the railroad's signal system to warn train engineers of mudslides or rockslides. If the fence is activated through the movement of soil, rocks, or trees from the surrounding area, the nearest signals in the area will turn red. An indicator will also display on the dispatcher's screen.

[7] Predeparture inspection is required by 49 *CFR* 232.205 and requires that cars be inspected to determine compliance with FRA Railroad Freight Car Safety Standards.

affected region, which could occur in the days preceding the alert.[8] The dispatchers then forwarded the e-mail alerts in the form of a bulletin to the appropriate train crews in the areas affected by the alerts, who then adjusted their operations as necessary.

CSX's static criterion for a flash flood alert was 3 inches of rain or more in a particular geographic area over a period of 3 hours or less. The provider would also send alerts for weather events such as snow, ice, winds, tornado watches, or severe thunderstorm watches. At the time of the derailment, there were no weather alert criteria for long-term weather events, such as accumulating precipitation over a period of days, weeks, or months.

During the course of this investigation, the NTSB reviewed the weather alert criteria for most of the Class I railroads, including CSX, and some major short line railroads and learned that most of them used static criteria that had not changed in 20 years. Other industries, such as the National Weather Service, the US Geological Survey, and the US Army Corps of Engineers, have used dynamic criteria that consider initial conditions for weather alerts.[9] Dynamic criteria account for unusual increases in precipitation or other unusual changes in weather and the alerting criteria levels could change depending on the environment and how preceding weather events have affected it. For example, dynamic weather alert criteria may take into account ground saturation from previous rainfalls when determining the effect that 3 inches of rain falling in an hour would have on a particular geographic area.

1.4 Mudslides and Weather

1.4.1 Mudslide Information

A review of rainfall amounts in the 2 weeks before the derailment showed a total precipitation amount of between 5 and 7.5 inches in the area of the derailment, over 300 percent more than normal.[10] As the soil saturation increased with successive rain days, the weight of water-saturated soil (ground cover) succumbed to gravity, tore apart from the upper reaches of the slope, and released toward the track

[8] As part of their service, the weather provider collaborated with CSX to develop static criteria for determining if a weather alert is warranted based on CSX's perceived business and safety needs.

[9] For an example of dynamic monitoring, see ESRI, *Flood Gauge Monitoring Dashboards*, accessed May 2, 2022.

[10] The calculations for the normal accumulated precipitation percentage were from the years 1981 through 2010 and used the Midwestern Regional Climate Center application tools. Normal accumulated precipitation percentage is updated and released every 10 years, so these data are the most current.

structure, carrying with it vegetation, brush, trees, and rock. In a February 19, 2020, letter to the NTSB, a representative from the Kentucky Division of Abandoned Mines and Lands stated that the landscape directly above the mudslide area and the point of derailment formed a "natural drain" that funneled the debris onto the track.

Two local storm reports issued by the National Weather Service the evening before the accident (February 12) at 10:27 p.m. and 11:40 p.m. reported mudslides in Yeadon, Kentucky, and Eversole, Kentucky. The mudslide near Yeadon, Kentucky, was 50 miles west-northwest of the derailment site (mudslide 1) and the mudslide near Eversole, Kentucky, was 60 miles west-northwest of the derailment site (mudslide 2).[11] Figure 4 shows a satellite image with the location of the two mudslides the evening before the derailment, as well as the origination and destination points for the train and the location of the derailment.

[11] In some situations, the National Weather Service will adjust the city/locations in its bulletins so that they reflect locations the general public would be more likely to know. Therefore, the location of the first mudslide is reflected in the weather bulletin found in the docket for this investigation as "near Owesley, Kentucky," and the location of the second mudslide is reflected in the weather bulletin as "near Breathitt, Kentucky."

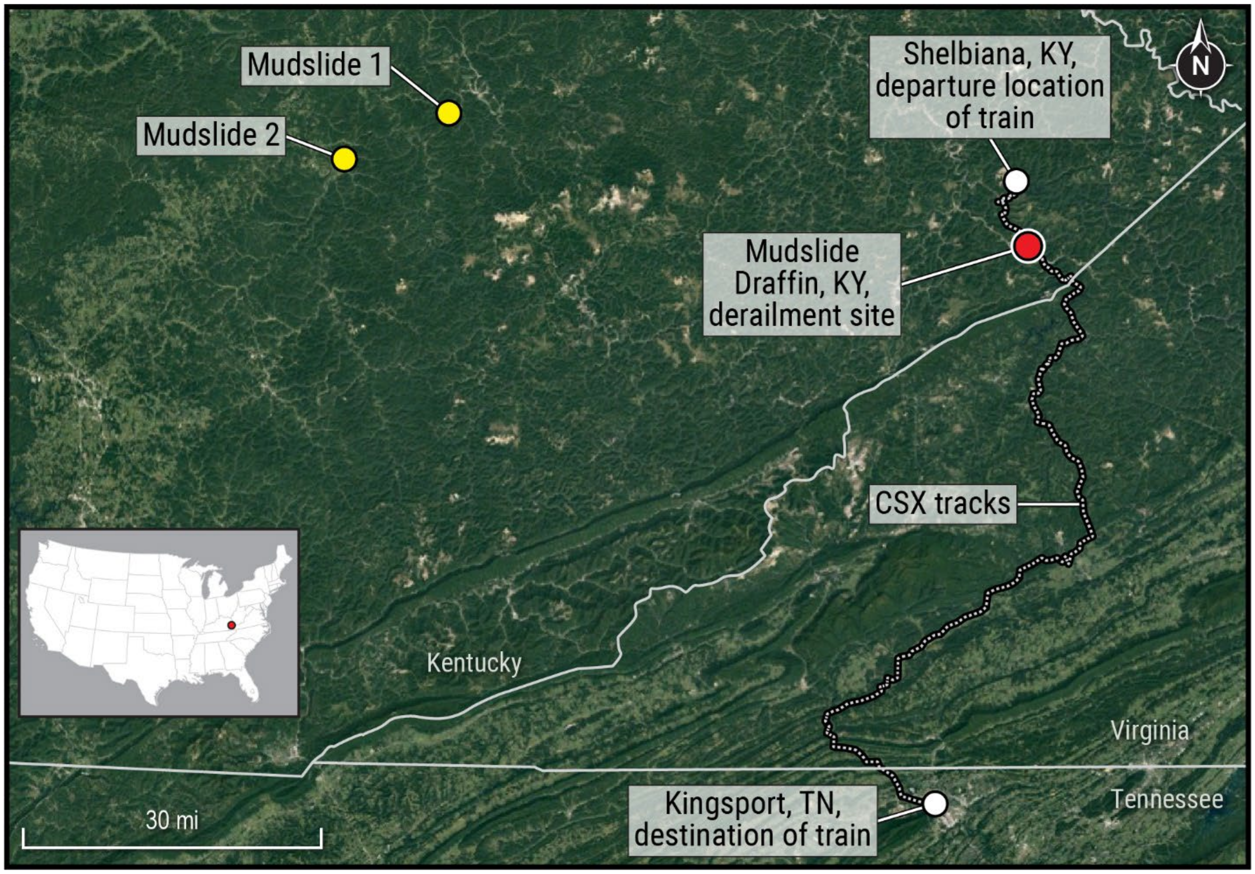

Figure 4. Location of two mudslides the evening before the derailment in relation to the train's departure location, destination, and the derailment site.

1.4.2 Weather Information

According to the official National Weather Service weather observation station closest to the derailment site, Pike County Airport-Hatcher Field, at the time of the derailment the area was experiencing moderate rainfall with visibilities as low as 4 miles and a south-to-southwest surface wind of 6 mph. A cold front was moving eastward, bringing bands of rain to the derailment area. The next-generation weather radar data closest to the derailment site indicated that between 7:30 p.m. on February 11 and the time of the derailment on February 13, 0.56 inches of precipitation fell.[12] While the precipitation amount over the 36-hour period was not extreme for the area, the data from Jackson, Kentucky, the closest local climate site,

[12] The *Next Generation Weather Radar* system is a network of over 160 high-resolution radars jointly operated by the National Weather Service, the Federal Aviation Administration, and the US Air Force.

indicated that the area had received precipitation of 4.38 inches above normal since January.[13]

In the month before the derailment, not only had the precipitation amounts been well above normal, the average temperature across eastern Kentucky and the derailment region had been between 6° and 8°F above normal with less snowfall.[14] When precipitation primarily falls as rain, it immediately is absorbed by the ground. When it falls as snow, there is a much slower release of that precipitation into the ground. The area experienced a significant deficit of snow before the derailment; since December 1, 2019, only 3.8 inches of snow fallen versus the average of 15.4 inches of snow. This was due, in part, to the above-normal temperatures noted above, including on the day of the derailment; the average minimum temperature was 8°F above normal and the high temperature was 9°F above normal.

Figure 5 shows the accumulated precipitation in the area, including the derailment site, for both a 1-month and a 1-week period before the derailment. As shown at the top of the figure, the area around the derailment site received 300 percent of its normal accumulated precipitation in the month before the derailment. The bottom of the figure shows the area received and between 500 percent and 750 percent of its normal accumulated precipitation in the week before the derailment.

[13] The National Weather Service, Federal Aviation Administration, and the Department of Defense obtain local climatological information from airport and other prominent weather stations. The product includes hourly observations, associated remarks, and a record of hourly precipitation for the entire month.

[14] The average temperature comparison was determined using the Midwestern Regional Climate Center application tools.

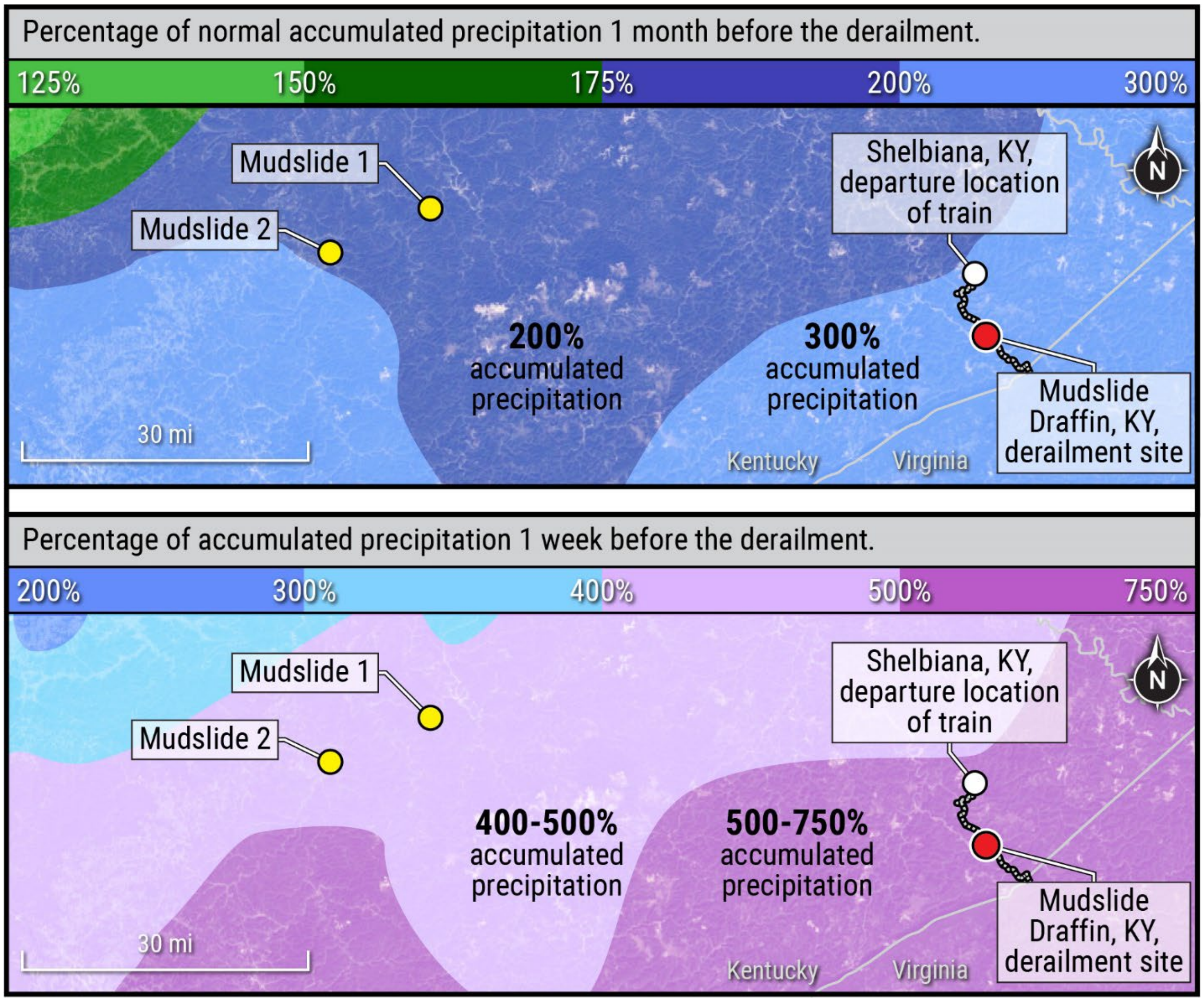

Figure 5. Graphic displays of the percentage of normal accumulated precipitation for both 1 month and 1 week before the derailment.

1.5 Personnel Information

The engineer was hired by CSX on July 11, 1994. After becoming a conductor, he entered the locomotive engineer training program and was certified on April 8, 1997. He had a current certification as an engineer under Title 49 *Code of Federal Regulations* (*CFR*) Parts 240 and 242. He passed his last operational test on

January 9, 2020, and passed his last physical characteristics and rules exams on January 21, 2020.[15]

The conductor was hired by CSX on March 23, 1998. After becoming a conductor, he entered the locomotive engineer training program and was certified as an engineer on January 20, 2006, and was current under 49 *CFR* Parts 240 and 242. He passed his last operational test on January 17, 2020, and passed his last physical characteristics and rules exams on January 27, 2020.

1.6 Test and Inspections

1.6.1 Track and Structure

Before the damaged equipment was moved, the NTSB documented and measured the resting positions of the equipment and established a point of derailment. Due to the ongoing unstable nature of the mudslide, the NTSB had to rely upon measurement of the track structure that was performed the day before the derailment. Those measurements showed the track structure met the minimum regulatory guidelines found in FRA's Track Safety Standards for Class 3 track.[16] There were no notable defects found, and the curve characteristics and authorized speed were within the FRA's Track Safety Standards requirements. The NTSB reviewed CSX track inspection records and found that during 2019 and 2020, CSX conducted 27 special inspections in the area of the derailment because of severe weather, flooding, or mudslides.[17] No documented issues were discovered.

1.6.2 Signal System

The NTSB conducted a postaccident examination of the signal system near the derailment and found all wayside signal equipment and appurtenances and the intermediate signal at milepost 123.6 locked and secured with no evidence of tampering or vandalism. The signals near the derailment site were all tested, and no defects were noted. The NTSB reviewed railroad signal maintenance, inspection, and monthly, quarterly, locking, and relay test records for all wayside signal locations near

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[15] *Physical characteristics* means the actual track profile of and physical location for points within a specific yard or route that affect the movement of a locomotive or train. Engineers are required to be qualified on the physical characteristics of the territory pursuant to the railroad's certification program.

[16] Title 49 *CFR* Part 213.

[17] According to 49 *CFR* 213.239, "In the event of fire, flood, severe storm, or other occurrence which might have damaged track structure, a special inspection shall be made of the track involved as soon as possible after the occurrence and, if possible, before the operation of any train over that track."

the derailment location and found no issues. There were also no unrepaired conditions identified in the records.

1.6.3 Mechanical Inspection

A complete visual examination of the mechanical components of the train for compliance with minimum safety standards and an FRA Class I air brake test were performed by the NTSB on the cars that did not derail. The examination revealed no deficiencies and all brakes applied and released appropriately.

Federal regulations outlined in 49 *CFR* 229.21 require that each locomotive in use be inspected at least once each calendar day. Federal regulations outlined in 49 *CFR* 229.23 call for additional periodic inspections of locomotives.[18] The NTSB reviewed the daily and periodic inspection records from all locomotives involved in the derailment. In addition, the NTSB reviewed periodic maintenance records for the locomotives and inspected the end-of-train device for proper calibration, communication, and functionality and found no issues.

1.6.4 Tank Car Inspection

The first derailed tank car in the consist had been converted to specification DOT-117R; it sustained a severe angular dent to its leading head shield, most likely during impact with one of the derailed locomotives as the tank car was pushed forward by trailing tonnage (NTSB 2020).[19] It was followed by three DOT-111 tank cars (two of which were breached), then three DOT-117R tank cars. The ability of the first tank car to retain all its lading was due in large part to it being equipped with a head shield. However, the second and third tank cars, both legacy specification DOT-111 tank cars, were not so equipped. The second tank car was punctured in its unprotected leading head and right-side tank shell after experiencing similar derailment impact conditions and it released its entire load of denatured ethanol, which in combination with diesel fuel from the locomotives ignited to form a pool fire. The unprotected leading head of the third tank car was punctured when it impacted

[18] The interval between two periodic inspections is 184 days for locomotives equipped with advanced microprocessor-based onboard electronic condition monitoring controls and 92 days for locomotives without such controls. Each periodic inspection is recorded on FRA form F6180-49A.

[19] (a) A *head shield* is a minimum ½-inch thick steel head covering that is designed to increase the puncture resistance of tank heads as part of the requirements for tank head puncture-resistance systems outlined in 49 *CFR* 179.202-5. (b) DOT-117R tank cars were originally DOT-111 tank cars with 7/16-inch or 1/2-inch-thick heads and shells that were retrofitted with the addition of the following: 1/2-inch-thick head shields, tank jackets and thermal protection blankets, a bottom outlet valve operating mechanism designed to remain closed under accident conditions, and top fittings protective housings.

the third locomotive's front platform or pilot structure.[20] The pool fire engulfed the second and third tank cars (cars three and four in the consist) and all three locomotives, including the lead locomotive cab, which were destroyed by the fire.

1.7 Placement of DOT-111 Tank Cars in High Hazard Flammable Trains and the Use of Buffer Cars for the Protection of Train Crews

Based on the circumstances of this derailment, and others like it in which trains using DOT-111 tank cars caught fire, the NTSB issued *Placement of DOT-111 Tank Cars in High Hazard Flammable Trains and the Use of Buffer Cars for the Protection of Train Crews*, on December 2, 2020 (NTSB 2020).

In this report, the NTSB discussed the need to place the most vulnerable tank cars of HHFTs in positions in the consist where there would be a lower risk of derailment and breach. The NTSB issued the following safety recommendation to the Association of American Railroads (AAR), the American Short Line and Regional Railroad Association (ASLRRA), and the Renewable Fuels Association (RFA):

> Develop and adopt guidelines and recommended practices for the systematic placement of the most vulnerable tank cars in high hazard flammable trains, such as unmodified US Department of Transportation-111 tank cars, in positions of trains where they are least likely to derail or to sustain mechanical damage from the effects of trailing tonnage or collision in an accident. (R-20-27)

In response, the RFA updated its *Best Practices for Rail Transport of Ethanol* guidance with a suggested best practice for placement of DOT-111 and DOT-117 cars in a train consist. ASLRRA informed its members of additional resources when moving hazardous materials, published safety recommendation R-20-27 in its newsletter, and sent a copy of RFA's *Best Practices for Rail Transport of Ethanol* guidance to its members. The responses from RFA and ASLRRA are classified "Closed−Acceptable Action." The AAR said in a January 4, 2021, correspondence to the NTSB that "an AAR analysis of the costs and benefits of various train placement options for ethanol cars in unit trains would be a costly and time-consuming exercise, unlikely to be completed much before all such cars are completely off the system in 2023." Therefore, the response from AAR is currently classified "Open—Unacceptable Response" because of their lack of action.

[20] The *pilot* is a fender-like structure mounted at the front of a locomotive to deflect obstacles on the track.

The NTSB also reiterated and classified the following two safety recommendations to the Pipeline and Hazardous Materials Safety Administration (PHMSA):

> Evaluate the risks posed to train crews by hazardous materials transported by rail, determine the adequate separation distance between hazardous materials cars and locomotives and occupied equipment that ensures the protection of train crews during both normal operations and accident conditions, and collaborate with the Federal Railroad Administration to revise 49 *Code of Federal Regulations* 174.85 to reflect those findings. (R-17-1)
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> Pending completion of the risk evaluation and action in accordance with its findings prescribed in Safety Recommendation R-17-01, withdraw regulatory interpretation 06-0278 that pertains to 49 *Code of Federal Regulations* 174.85 for positioning placarded railcars in a train and require that all trains have a minimum of five nonplacarded cars between any locomotive or occupied equipment and the nearest placarded car transporting hazardous materials, regardless of train length and consist. (R-17-2)

Both of these recommendations are on the NTSB's current Most Wanted List of Transportation Safety Improvements (MWL) in the issue area "Improve Rail Worker Safety."

In response to Safety Recommendation R-17-1, PHMSA sponsored a research project at the John A. Volpe National Transportation Systems Center (Volpe) to determine the appropriate separation distance of train crews from hazardous materials cars. The Volpe project includes reciprocal peer reviews with Transport Canada of their research on separation distance, which was done as part of Transport Canada's development of guidelines for train marshalling and handling. The NTSB classified Safety Recommendation R-17-1 "Open—Acceptable Response."

PHMSA disagreed with Safety Recommendation R-17-2 because it believed that withdrawal of the letter of interpretation was premature and would cause unnecessary confusion within the regulated community in the absence of a rulemaking proposing a change that would provide the public with an opportunity to comment.[21] PHMSA also believed that such a proposed change would require justification through supporting safety and cost data. Safety Recommendation R-17-2 was classified "Open—Unacceptable Response."

Additionally, the NTSB also reiterated Safety Recommendation R-17-3 to the FRA. This recommendation is also on the NTSB's current MWL in the issue area "Improve Rail Worker Safety."

> Evaluate the risks posed to train crews by hazardous materials transported by rail, determine the adequate separation distance between hazardous materials cars and locomotives and occupied equipment that ensures the protection of train crews during both normal operations and accident conditions, and collaborate with the Pipeline and Hazardous Materials Safety Administration to revise 49 *Code of Federal Regulations* 174.85 to reflect those findings. (R-17-3)

The NTSB classified Safety Recommendation R-17-3 "Open—Acceptable Response."

1.8 Other Weather-Related Derailments

In the past 40 years, the NTSB has investigated other derailments where adverse weather conditions, particularly rainfall, affected the railroads' infrastructure and created unsafe operationing conditions. On July 7, 1984, Amtrak (National Railroad Passenger Corporation) passenger train 60, the Montrealer, derailed while passing over a washed-out section of gravel embankment under the main track of the Central Vermont Railway near Essex Junction, Vermont. As a result of the derailment, 3 passengers, a sleeping car attendant, and a crewmember died, and 26 passengers, 2 sleeping car attendants, and a crewmember were seriously injured. The night before the derailment, a series of intense storms with varying amounts of rainfall occurred in the area near the derailment. Some localities received as little as an inch of rain, while others received as much as 10 inches of rain during the evening, resulting in flash flooding (NTSB 1985).

On August 9, 1997, Amtrak train 4, the Southwest Chief, derailed on the BNSF Railway tracks about 5 miles northeast of Kingman, Arizona. The engineer and

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[21] Following the October 20, 2006, derailment of Norfolk Southern Corporation train 68QB119 on a bridge over Beaver River in New Brighton, Pennsylvania, the NTSB asked PHMSA to clarify the train placement requirements prescribed in 49 *CFR* 174.85 for unit trains consisting of hazardous materials. In response, on March 29, 2007, PHMSA issued regulatory interpretation 06-0278 stating that when the length of a train does not permit placement of a placarded car no nearer than the sixth car from the engine or occupied caboose, the placarded car must not be placed nearer than the second car from the from the engine or occupied caboose.

assistant engineer saw a "hump" in the track as they approached a bridge. The train then derailed as it crossed the bridge. As a result of the derailment, 173 passengers and 10 employees were injured (NTSB 1998). The investigation revealed that the ground under the bridge's supporting structure had been washed away by a flash flood. In response to the derailment, the FRA issued an amendment to Safety Advisory 97-1 that permitted the use of other "competent" commercial weather services that receive and review warnings and weather data from the National Weather Service as part of its procedures (FRA 1997).[22]

On January 19, 2009, at 8:36 p.m., an eastbound Canadian National Railroad freight train derailed 19 loaded hazardous materials tank cars due to a washed-out track condition near a public road crossing near Cherry Valley, Illinois. Following the derailment, 13 of the derailed tank cars breached and lost product, resulting in a fire. As a result of the derailment, one person died, seven people were injured, and 600 residents were evacuated. On the day of the derailment, a nearby airport recorded 3.59 inches of rain between 6:09 p.m. to 7:39 p.m. In the 24 hours before the derailment, the same airport recorded 4.18 inches of precipitation. Furthermore, during the month of the derailment, the area received 7.36 inches of rainfall, which was 2.56 inches above normal (NTSB 2012).

On May 19, 2018, southbound CSX freight train X41518 derailed as it approached a bridge overpass in Alexandria, Virginia. A severe thunderstorm warning had been in effect for the area until about 4 hours before the time of the derailment and about 5.5 inches of rain fell in the area during the 10 days before the derailment. The track was supposed to have been inspected on the day before the derailment, however the inspector was diverted and instructed to inspect another location 24 miles away because of a flash flood warning. Although it was not raining at the time of the derailment, water had saturated the soil over time, causing the subgrade fill to subside from the track structure (NTSB 2020a).[23]

On April 24, 2019, a Union Pacific Railroad HHFT carrying denatured ethanol derailed 26 tank cars in Fort Worth, Texas. As in the previously mentioned derailments, heavy rain fell for several consecutive days preceding the derailment.

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[22] Previously, Safety Advisory 97-1 recommended that railroads have a procedure in place to ensure that railroad dispatchers be notified within 15 minutes of the issuance of flash flood warnings from only the National Weather Service.

[23] (a) *Subgrade* is the natural materials, gravel, or crushed rock, usually inferior to ballast or sub-ballast, placed in fills or at the bottom of cuts that lie directly below the sub-ballast. (b) *Fill* is subgrade material, such as soil and rock, that is used to establish the grade on which the track structure is built. (c) An example of a subgrade fill failure can be found in Figure 2 of *CSX Transportation Freight Train Derailment and Bridge Collapse, Alexandria, Virginia, May 19, 2018* (RAB-20/01). (d) *Subsided* means railroad ballast that has sunk or moved away to a low or lower level beneath track rails and ties.

However, the rainfall amount at the time of the derailment did not meet the threshold for a flash flooding alert. Similar to the Draffin derailment, Union Pacific Railroad used a weather provider with specific static criteria for notifying dispatchers about particular weather events to forward to the appropriate train crews (NTSB 2021).

1.9 CSX Postaccident Actions

Since this derailment, CSX has revised its weather alert parameters so that the weather alert contractor now provides additional information, such as "accumulative rainfall" alerts or areas of concern on CSX tracks where passenger and hazardous materials trains operate. CSX then chooses whether to disseminate this information to the train crews or take additional safety action. Additionally, CSX has increased inspection frequency and enhanced its capability to query areas or hot spots that are affected by weather and weather-related damages.[24] For instance, CSX has increased its track inspections when 1 inch or more of rain is forecast per hour, ensuring the tracks are inspected before every train traverses them; the inspections start when the rain is forecast to begin and continue until at least 8 hours from the time the rain stops. Inspections for substantial hillside runoff also occur during this time period. Longer term, CSX is working with a drone contractor to facilitate track inspections for flooding and landslides.

In Draffin, CSX installed a culvert under the track around the mudslide, dug into the hillside to create a reservoir for future accumulation of water and residual debris, and installed a slide detection fence above the improvements.

[24] *Hot spots* are known areas that have been previously noted as likely to present a risk to operations.

2. Analysis

2.1 Introduction

On February 13, 2020, after over a month of substantial precipitation near Draffin, Kentucky, a mudslide fell on the CSX railroad track. A CSX HHFT carrying denatured ethanol was traveling on the track and derailed. Two DOT-111 tank cars breached and released 38,400 gallons of denatured ethanol that combined with diesel fuel from the locomotives, ignited, and caught fire.

This analysis discusses the derailment and the following safety issues:

- High-risk placement of DOT-111 tank cars. (See section 2.2.)
- Impact of weather conditions on railroad operations. (See section 2.3.)

Having completed a comprehensive review of the circumstances that led to the derailment, the investigation established that the following factors did not contribute to its cause:

- *CSX's track inspection and maintenance program*. The NTSB reviewed CSX track inspection records and special inspection records and found no evidence that pre-existing track conditions contributed to the derailment.
- *CSX's signaling system*. The NTSB found the signaling system to be working correctly. Although the mudslide obstructed the rails, it did not cause the rails to break or separate, which would have disrupted the track circuits and affected the signals. In addition, the NTSB reviewed railroad signal maintenance, inspection, and test records for monthly, quarterly, locking, and relay tests for all wayside signal locations in the area and found no issues that would have contributed to the derailment. In addition, no unrepaired conditions were identified in the records.
- *Mechanical condition of the train*. The NTSB found no anomalies or defects during the mechanical examination of the train that would have caused or contributed to the derailment.
- *Actions of the train crew before and during the operation of the train*. The NTSB found that the actions of the crew were appropriate before and at the time of the accident. According to the trip optimizer log, the train was being operated at or below the authorized speed for the track. Further, postaccident drug and alcohol testing were negative.

Therefore, the NTSB concludes that none of the following contributed to the derailment: (1) CSX's track inspection and maintenance programs, (2) CSX's signaling system, (3) the mechanical condition of the train, and (4) the actions of the train crew before and during the operation of the train.

2.2 Accident Summary

Although the train crew had received a bulletin warning them to watch for a mudslide farther down the track, they had no prior knowledge of the potential of a mudslide occurring at the derailment location. The train crew was operating on clear signal indications because the mudslide did not break the signal system circuits. The engineer reported that the sight distance ahead of the train was about five car lengths due to rain, fog, curves, and darkness. When he identified that the track was blocked by a mudslide, the engineer applied the emergency brakes. The NTSB concludes that although the train was traveling at the authorized speed and the engineer applied emergency brakes as early as practicable upon identifying the track was blocked by the mudslide, there was insufficient sight distance for the engineer to recognize the mudslide and apply the brakes in time to stop the train before it collided with the mudslide.

Two legacy DOT-111 tank cars were placed in positions three and four of the consist, and they were punctured during the derailment. Although the DOT-117R tank cars in front of and to the rear of the DOT-111 tank cars sustained significant impact damage, their head shields protected these cars from breaching. The other DOT-111 tank car did not sustain any breaching or fire damage. Thus, the NTSB concludes that the severity of this derailment could have been mitigated had the two breached DOT-111 tank cars been placed in locations within the train consist where they were less likely to derail or to sustain damage from the derailment.

In the NTSB's Safety Recommendation Report, *Placement of DOT-111 Tank Cars in High Hazard Flammable Trains and the Use of Buffer Cars for the Protection of Train Crews*, the NTSB found that insufficient separation distance between the lead locomotive and tank cars carrying ethanol increased the risk of death or serious injury to the train crew from a hazardous materials release. PHMSA's regulatory interpretation of 49 *CFR* 174.85 has allowed railroads to operate HHFTs with only a single nonplacarded buffer car separating train crews from hazardous materials cars.[25] If PHMSA were to withdraw regulatory interpretation 06-0278, as recommended in Safety Recommendation R-17-2, all trains carrying hazardous materials would require a minimum of five nonplacarded cars between any locomotive or occupied equipment and the nearest placarded car transporting

[25] The regulation does not provide for the use of locomotives as buffer cars themselves. Although the train that derailed in Draffin, Kentucky, had three locomotives at the head end, the regulation only provides restrictions for the placement of placarded hazardous materials cars near "the engine" without distinguishing whether the engine is occupied.

hazardous material. In this derailment, when the head end of the HHFT derailed, the high-energy state caused by trailing tonnage and run-in forces pushed breached hazardous materials tank cars dangerously close to the occupied locomotive. The burning tank cars that came to rest close to the locomotive cut off the train crew's only means of safe egress. Thus, the NTSB concludes that a single buffer car does not provide sufficient separation distance for the protection of train crews when the head end of a HHFT becomes involved in a derailment. Recommendations addressing this safety issue were made in the NTSB Safety Recommendation Report, *Placement of DOT-111 Tank Cars in High Hazard Flammable Trains and the Use of Buffer Cars for the Protection of Train Crews* and are discussed in section 1.7.

2.3 Impact of Weather Alert Criteria in Railroad Operations

According to the US Geological Survey, the most frequent and widespread damaging landslides in the United States are induced by prolonged or heavy rainfall.[26] As discussed in section 1.4.1, between 5 and 7.5 inches of rain fell in the area of the derailment in the 2 weeks prior, which was over 300 percent of the normal precipitation. According to Midwestern Regional Climate Center data, between 500 and 750 percent of normal precipitation fell in the week leading up to the derailment. Not only had the precipitation amounts been well above normal, but the average temperature in the area had been between 6° and 8°F above normal for the month before the derailment leading to little-to-no snowfall accumulation at the derailment site or in the higher terrain above the derailment site. This resulted in most of the precipitation falling as rain, which continued to soak the hillside. If the precipitation fell as snow (at higher elevations) the liquid would be released more slowly from the melted snow into the ground or hillside. Further, the landscape directly above the mudslide area and the point of derailment formed a v-shaped "natural drain" that funneled the debris onto the track.

The NTSB concludes that the above-normal rainfall and elevated temperatures in the weeks before the derailment led to the soil being saturated, and the sloped natural drain environment formed by the landscape created an environment favorable for a mudslide to occur, and a mudslide subsequently covered the track, obstructing the safe passage of the train and causing the derailment.

As discussed in section 1.8, in the past 40 years the NTSB has investigated five other derailments where significant precipitation before the accident created flooding, washouts, and other situations that damaged the roadbed and created unsafe operating conditions, including the April 2019 derailment in Fort Worth, Texas (NTSB 2021). In both the Draffin and Fort Worth derailments, the rainfall and resulting

[26] For more information, see US Geological Survey, *Landslides 101*, accessed May 3, 2022.

mudslide or washed-out (subsided) roadbed led to the derailment of HHFTs and the release of hazardous materials. A review of the weather alert criteria and documentation used by most Class I railroads and some short line railroads indicated that the railroads had used the same weather alert thresholds for 20 years or longer. Further, the rainfall amounts at the times of the Fort Worth and Draffin derailments did not meet the railroad or weather contractor alert criteria for heavy periods of rain, flash flooding, or mudslide risk. In the Draffin accident, CSX's weather alert criterion was 3 inches of rain within 3 hours, and the weather that day did not meet the criterion. As a result, the weather contractor did not provide any notifications, CSX did not conduct any special track inspections, and the existing weather alert criterion did not adequately warn of the dangers created by the recent heavy rains. Had CSX known that the conditions that occurred in the weeks before the accident meant that the rain falling on the day of the accident could have a potential impact on track conditions, adjustments could have been made to train operations in that area to eliminate the possibility that a landslide would be encountered.

Adverse weather conditions can cause dangerous situations such as flash floods, mudslides, or other unsafe conditions. These adverse conditions can affect a railroad quickly or the effect can build over time, such as long periods of accumulated precipitation that saturates the terrain and overflows rivers, lakes, streams, and ponds.

The weather alert criteria agreed to by CSX and the weather provider did not adequately consider the risks created by weather conditions that were wetter than normal nor did it consider periods of precipitation occurring over longer timeframes. For weather alert warnings to be truly beneficial in railroad operating environments, the alert criteria need to accommodate weather conditions that persist over periods of time, such as rain and snow, and include terrain influences and effects of climate change. Taking these dynamic weather conditions into consideration could then be automated through software displayed on a railroad supervisor's dashboard or by dispatchers.

Were railroads to update alert criteria that consider impactful weather events that occur over short and long periods of time (dynamic weather conditions), improved weather information and alerts could be delivered to railroads in a timely manner, which could allow for operational changes that address potential hazards to the track. The NTSB concludes that providing dynamic weather alerts that take into account current, persistent, and past weather conditions would allow railroad operators to identify potential hazards and make more informed decisions related to their infrastructure. Therefore, the NTSB recommends that Class I Railroads and Amtrak revise their criteria for train operations to provide dynamic weather alerts that take into account current, persistent, and past weather conditions to improve location-based adverse weather alerts. The NTSB also recommends to the Class I Railroads and Amtrak that, once the weather alert criteria are revised based on Safety

Recommendation R-22-8, ensure that railroad operational and engineering personnel are aware of the revision and that they adopt any changes in practices or protocols it may require. Furthermore, the NTSB recommends that the ASLRRA and the American Public Transportation Association inform their members of the circumstances of this derailment and encourage them to revise as necessary their criteria for train operations to provide dynamic weather alerts that take into account current, persistent, and past weather conditions to improve location-based adverse weather alerts.

3. Conclusions

3.1 Findings

1. None of the following contributed to the derailment: (1) CSX Transportation's track inspection and maintenance programs, (2) CSX Transportation's signaling system, (3) the mechanical condition of the train, and (4) the actions of the train crew before and during the operation of the train.

2. Although the train was traveling at the authorized speed and the engineer applied emergency brakes as early as practicable upon identifying the track was blocked by the mudslide, there was insufficient sight distance for the engineer to recognize the mudslide and apply the brakes in time to stop the train before it collided with the mudslide.

3. The severity of this derailment could have been mitigated had the two breached US Department of Transportation-111 tank cars been placed in locations within the train consist where they were less likely to derail or to sustain damage from the derailment.

4. A single buffer car does not provide sufficient separation distance for the protection of train crews when the head end of a high hazard flammable train becomes involved in a derailment.

5. The above-normal rainfall and elevated temperatures in the weeks before the derailment led to the soil being saturated, and the sloped natural drain environment formed by the landscape created an environment favorable for a mudslide to occur, and a mudslide subsequently covered the track, obstructing the safe passage of the train and causing the derailment.

6. Providing dynamic weather alerts that take into account current, persistent, and past weather conditions would allow railroad operators to identify potential hazards and make more informed decisions related to their infrastructure.

3.2 Probable Cause

The National Transportation Safety Board determines that the probable cause of the February 13, 2020, derailment of CSX Transportation train K42911 was loose mud, vegetation, sand, soil, and rock from a mudslide that obstructed the track following excessive rain accumulation over several weeks. Contributing to the derailment was CSX Transportation's use of a weather alert system in which notifications were developed and implemented that did not account for the impact of the unusual increases and accumulation of precipitation. Contributing to the severity of the derailment was a fire resulting from the release of hazardous materials from breached US Department of Transportation-111 tank cars damaged in the derailment. Also contributing to the severity of the derailment was the failure of the Pipeline and Hazardous Materials Safety Administration to withdraw regulatory interpretation 06-0278 that pertains to Title 49 *Code of Federal Regulations* 174.85, which allowed the use of a single nonplacarded buffer car between the locomotives and the first tank car containing hazardous materials if no other nonhazardous materials cars are available in the consist.

4. Recommendations

4.1 New Recommendations

As a result of this investigation, the National Transportation Safety Board makes the following new safety recommendations.

To the Class I Railroads and Amtrak:

1. Revise your criteria for train operations to provide dynamic weather alerts that take into account current, persistent, and past weather conditions to improve location-based adverse weather alerts. (R-22-8)

2. Once the weather alert criteria are revised based on Safety Recommendation R-22-8, ensure that railroad operational and engineering personnel are aware of the revision and that they adopt any changes in practices or protocols it may require. (R-22-9)

To the American Short Line and Regional Railroad Association and the American Public Transportation Association:

3. Inform your members of the circumstances of this derailment and encourage them to revise as necessary their criteria for train operations to provide dynamic weather alerts that take into account current, persistent, and past weather conditions to improve location-based adverse weather alerts. (R-22-10)

4.2 Previously Issued Recommendations

Based partly on this accident, on December 2, 2020, the National Transportation Safety Board issued a safety recommendation report titled *Placement of DOT-111 Tank Cars in High Hazard Flammable Trains and the Use of Buffer Cars for the Protection of Train Crews* RSR-20/01, which issued one new safety recommendation and reiterated three safety recommendations addressing safety issues identified during the Draffin derailment investigation (NTSB 2020).

To the Association of American Railroads, the American Short Line and Regional Railroad Association, and the Renewable Fuels Association:

Develop and adopt guidelines and recommended practices for the systematic placement of the most vulnerable tank cars in high hazard flammable trains, such as unmodified US Department of Transportation-111 tank cars, in positions of trains where they are least likely to derail or to sustain mechanical damage from the effects of trailing tonnage or collision in an accident. (R-20-27)

Safety Recommendations R-17-1 and R-17-2 to the Pipeline and Hazardous Materials Safety Administration:

Evaluate the risks posed to train crews by hazardous materials transported by rail, determine the adequate separation distance between hazardous materials cars and locomotives and occupied equipment that ensures the protection of train crews during both normal operations and accident conditions, and collaborate with the Federal Railroad Administration to revise 49 *Code of Federal Regulations* 174.85 to reflect those findings. (R-17-1)

Pending completion of the risk evaluation and action in accordance with its findings prescribed in Safety Recommendation R-17-01, withdraw regulatory interpretation 06-0278 that pertains to 49 *Code of Federal Regulations* 174.85 for positioning placarded railcars in a train and require that all trains have a minimum of five nonplacarded cars between any locomotive or occupied equipment and the nearest placarded car transporting hazardous materials, regardless of train length and consist. (R-17-2)

Safety Recommendation R-17-3 to the Federal Railroad Administration:

Evaluate the risks posed to train crews by hazardous materials transported by rail, determine the adequate separation distance between hazardous materials cars and locomotives and occupied equipment that ensures the protection of train crews during both normal operations and accident conditions, and collaborate with the Pipeline and Hazardous Materials Safety Administration to revise 49 *Code of Federal Regulations* 174.85 to reflect those findings. (R-17-3)

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

JENNIFER HOMENDY
Chair

MICHAEL GRAHAM
Member

BRUCE LANDSBERG
Vice Chairman

THOMAS CHAPMAN
Member

Report Date: August 18, 2022

Appendixes

Appendix A: Investigation

The National Transportation Safety Board (NTSB) was notified on February 13, 2020, of the derailment in which CSX Transportation (CSX) freight train K42911, a high hazard flammable train carrying denatured ethanol, derailed at 6:46 a.m. local time in Draffin, Kentucky.

The NTSB launched an investigator-in-charge and a team to investigate track, signals and train control; railroad operations; meteorology; and mechanical functions. NTSB investigators from Washington, DC; Montana; Virginia; and Indiana assisted in the investigation.

Parties to the investigation included the Federal Railroad Administration; the Pipeline and Hazardous Materials Safety Administration; CSX; the Brotherhood of Locomotive Engineers and Trainmen; the International Association of Sheet Metal, Air, Rail and Transportation Workers–Transportation Division; and Trinity Industries Leasing Company.

Appendix B: Consolidated Recommendation Information

Title 49 *United States Code* 1117(b) requires the following information on the recommendations in this report.

For each recommendation—

(1) a brief summary of the Board's collection and analysis of the specific accident investigation information most relevant to the recommendation;

(2) a description of the Board's use of external information, including studies, reports, and experts, other than the findings of a specific accident investigation, if any were used to inform or support the recommendation, including a brief summary of the specific safety benefits and other effects identified by each study, report, or expert; and

(3) a brief summary of any examples of actions taken by regulated entities before the publication of the safety recommendation, to the extent such actions are known to the Board, that were consistent with the recommendation.

To the Class I Railroads and Amtrak:

R-22-8
Revise your criteria for train operations to provide dynamic weather alerts that take into account current, persistent, and past weather conditions to improve location-based adverse weather alerts.

Information that addresses the requirements of 49 *USC* 1117(b), as applicable, can be found in section 2.3, Impact of Weather Alert Criteria in Railroad Operations. Information supporting (b)(1) can be found on pages 20-22; (b)(2) can be found on page 20; and (b)(3) is not applicable.

R-22-9
Once the weather alert criteria are revised based on Safety Recommendation R-22-8, ensure that railroad operational and engineering personnel are aware of the revision and that they adopt any changes in practices or protocols it may require.

Information that addresses the requirements of 49 *USC* 1117(b), as applicable, can be found in section 2.3, Impact of Weather Alert Criteria in Railroad Operations. Information supporting (b)(1) can be found on pages 20-22; (b)(2) can be found on page 20; and (b)(3) is not applicable.

To the American Short Line and Regional Railroad Association and the American Public Transportation Association:

R-22-10
Inform your members of the circumstances of this derailment and encourage them to revise as necessary their alert criteria for train operations to provide dynamic weather alerts that take into account current, persistent, and past weather conditions to improve location-based adverse weather alerts.

Information that addresses the requirements of 49 *USC* 1117(b), as applicable, can be found in section 2.3, Impact of Weather Alert Criteria in Railroad Operations. Information supporting (b)(1) can be found on pages 20-22; (b)(2) can be found on page 20; and (b)(3) is not applicable.

References

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NTSB (National Transportation Safety Board). Derailment of Amtrak Passenger Train No. 60, the Montrealer, on the Central Vermont Railway, Near Essex Junction, Vermont, July 7, 1984. RAR-85/14. Washington, DC: National Transportation Safety Board.

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-----. 2021. *Union Pacific Railroad Derailment with Hazardous Materials Release and Subsequent Fire, Fort Worth, Texas, April 24, 2019.* RAB-21/03. Washington, DC: National Transportation Safety Board.

For more detailed background information on this report, visit the NTSB investigations website and search for NTSB accident ID RRD20FR002. Recent publications are available in their entirety on the NTSB website. Other information about available publications also may be obtained from the website or by contacting–

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