Federal Railroad Administration
Office of Railroad Safety
Accident and Analysis Branch

Accident Investigation Report
HQ-2017-1194

Union Pacific Railroad Company (UP)
Graettinger, IA
March 10, 2017

Note that 49 U.S.C. §20903 provides that no part of an accident or incident report, including this one, made by the Secretary of Transportation/Federal Railroad Administration under 49 U.S.C. §20902 may be used in a civil action for damages resulting from a matter mentioned in the report.

SYNOPSIS

Synopsis

On March 10, 2017, at 12:51 a.m., CST, Eastbound Union Pacific Railroad Company (UP) Train UEGKOT 09, an ethanol train, derailed 20 rail cars. The accident occurred approximately two miles east of Graettinger, Iowa, at Milepost 56.72, on UP's Twin Cities Service Unit, Estherville Subdivision.

Of the 20 derailed hazardous material (ethanol) cars, 14 cars released product. The derailment resulted in a short evacuation of seven people within a mile radius of the accident. There were no injuries to railroad employees or the public as a result of the derailment. Total Federal Railroad Administration (FRA) reportable damages for the derailment were $1,423.871.

At the time of the accident, it was dark and clear, with a temperature of 11° F.

FRA's investigation determined the probable cause of the accident was Cause Code T207-Broken rail (detail fracture from shelling or head check). There was no contributing factor found for this accident.

U.S. Department of Transportation
Federal Railroad Administration

FRA FACTUAL RAILROAD ACCIDENT REPORT

FRA File #HQ-2017-1194

TRAIN SUMMARY

1. Name of Railroad Operating Train #1	1a. Alphabetic Code	1b. Railroad Accident/Incident No.
Union Pacific Railroad Company	UP	0317TC008

GENERAL INFORMATION

1. Name of Railroad or Other Entity Responsible for Track Maintenance	1a. Alphabetic Code	1b. Railroad Accident/Incident No.
Union Pacific Railroad Company	UP	0317TC008

2. U.S. DOT Grade Crossing Identification Number	3. Date of Accident/Incident	4. Time of Accident/Incident
	3/10/2017	12:51 AM

5. Type of Accident/Incident
Derailment

6. Cars Carrying HAZMAT	7. HAZMAT Cars Damaged/Derailed	8. Cars Releasing HAZMAT	9. People Evacuated	10. Subdivision
98	20	14	7	Estherville

11. Nearest City/Town	12. Milepost *(to nearest tenth)*	13. State Abbr.	14. County
Graettinger	56.72	IA	PALO ALTO

15. Temperature (F)	16. Visibility	17. Weather	18. Type of Track
11 ˚F	Dark	Clear	Main

19. Track Name/Number	20. FRA Track Class	21. Annual Track Density *(gross tons in millions)*	22. Time Table Direction
Single Main Track	Freight Trains-40, Passenger Trains-60	2.4	East

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OPERATING TRAIN #1

1. Type of Equipment Consist:	2. Was Equipment Attended?	3. Train Number/Symbol
Freight Train	Yes	UEGKOT 09

4. Speed (recorded speed, if available) R - Recorded E - Estimated	Code	5. Trailing Tons (gross exluding power units)	6a. Remotely Controlled Locomotive? 0 = Not a remotely controlled operation 1 = Remote control portable transmitter 2 = Remote control tower operation 3 = Remote control portable transmitter - more than one remote control transmitter	Code
28.0 MPH	R	12699		0

6. Type of Territory

Signalization:
Not Signaled

Method of Operation/Authority for Movement:
Direct Train Control

Supplemental/Adjunct Codes:
P

7. Principal Car/Unit	a. Initial and Number	b. Position in Train	c. Loaded (yes/no)	8. If railroad employee(s) tested for drug/alcohol use, enter the number that were positive in the appropriate box	Alcohol	Drugs
(1) First Involved *(derailed, struck, etc.)*	DBUX 301674	23	yes		0	0
(2) Causing *(if mechanical, cause reported)*	N/A			9. Was this consist transporting passengers?		No

10. Locomotive Units (Exclude EMU, DMU, and Cab Car Locomotives.)	a. Head End	Mid Train b. Manual	Mid Train c. Remote	Rear End d. Manual	Rear End e. Remote	11. Cars (Include EMU, DMU, and Cab Car Locomotives.)	Loaded a. Freight	Loaded b. Pass.	Empty c. Freight	Empty d. Pass.	e. Caboose
(1) Total in Train	2	0	0	0	1	(1) Total in Equipment Consist	100	0	0	0	0
(2) Total Derailed	0	0	0	0	0	(2) Total Derailed	20	0	0	0	0

12. Equipment Damage This Consist	13. Track, Signal, Way & Structure Damage
1255474	168397

14. Primary Cause Code
T207 - Broken Rail - Detail fracture from shelling or head check

15. Contributing Cause Code

Number of Crew Members

16. Engineers/Operators	17. Firemen	18. Conductors	19. Brakemen
1	0	1	0

Length of Time on Duty

20. Engineer/Operator	21. Conductor
Hrs: 8 Mins: 21	Hrs: 8 Mins: 21

Casualties to:	22. Railroad Employees	23. Train Passengers	24. Others
Fatal	0	0	0
Nonfatal	0	0	0

25. EOT Device?	26. Was EOT Device Properly Armed?
Yes	Yes

27. Caboose Occupied by Crew? N/A

28. Latitude	29. Longitude
43.217880000	-94.722047000

SKETCHES

Sketch HQ-2017-1194

Reset Form | Import Form Data | Submit by Email | Print Form

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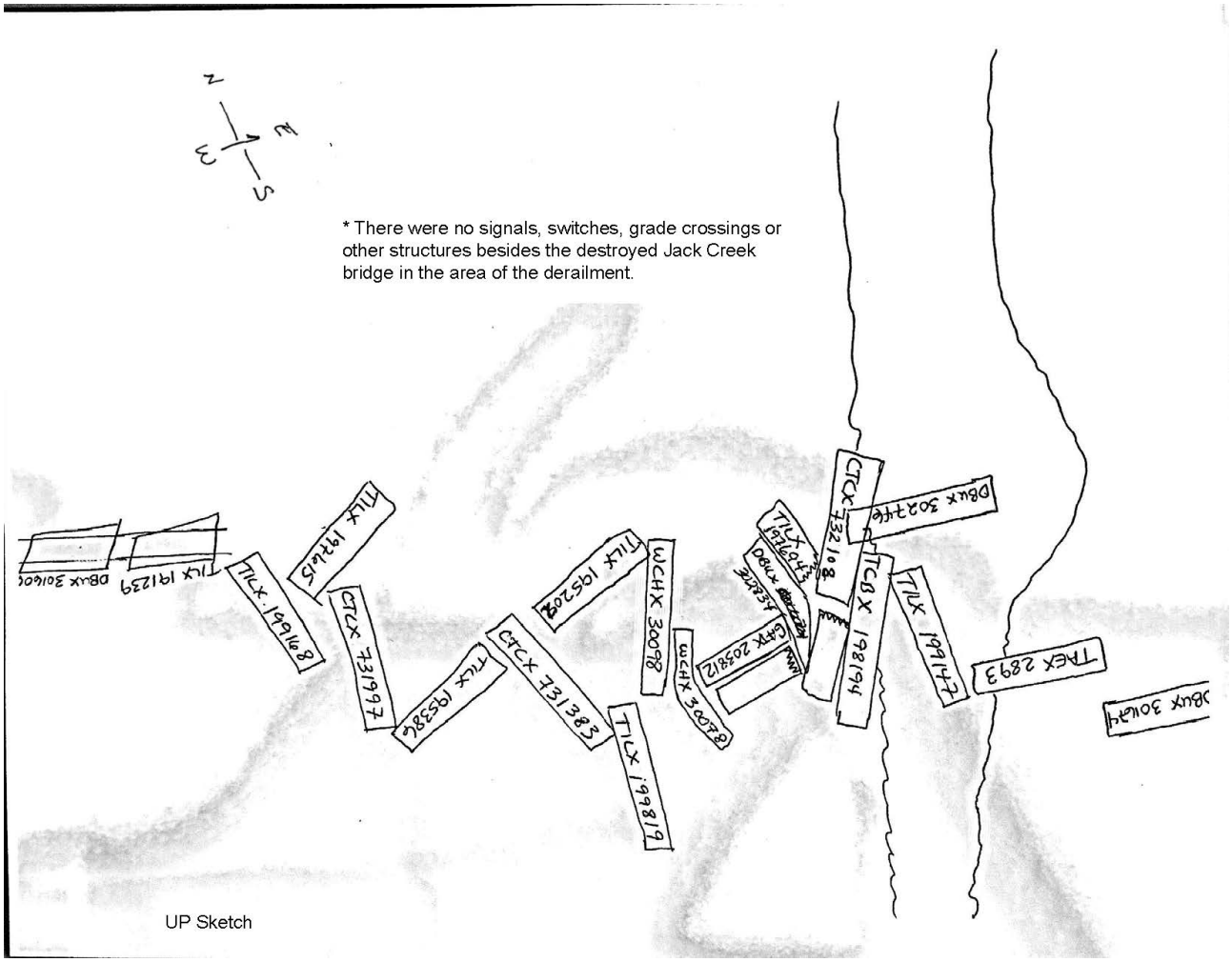
142. DRAW A SKETCH OF ACCIDENT AREA INCLUDING ALL TRACKS, SIGNALS, SWITCHES, STRUCTURES, OBJECTS, ETC., INVOLVED.

Delete Sketch



NARRATIVE

Circumstances Prior to the Accident

Eastbound Union Pacific Railroad Company (UP) Train UEGKOT 09 (the train) consisted of two locomotives on the head-end, one locomotive on the rear end, 100 loaded rail cars, and no empty rail cars. Of the 100 loaded rail cars, cars 2 - 99 were fully loaded with ethanol, and the first and last cars were idler cars loaded with sand utilized as a buffer between the hazardous material cars and the lead and rear locomotives. The train was 6,215 feet in length with 12,699 trailing tons.

The assigned crew of the train consisted of an Engineer and a Conductor. The crew went on duty at 4:30 p.m., CST, on March 9, 2017, in Eagle Grove, Iowa. This was the Engineer and Conductor's home terminal, and both had received more than the statutory off-duty period prior to reporting for duty. Their assignment was to take the train from Superior, Iowa, to Boone, Iowa.

After reporting for duty in Eagle Grove, Iowa, the train crew was transported by crew van to Estherville, Iowa, where they boarded the train. The train departed Estherville, Iowa at 7:36 p.m., EST, and traveled eight miles west to assemble the train at Green Plains Renewable Energy (Green Plains) in Superior, Iowa.

After setting out one bad order-car from the train in Superior, Iowa, the crew performed their required air brake test and departed eastbound at 11:30 p.m., EST, with 100 loaded rail cars. After departing Green Plains, the trip was uneventful and there were no issues with operation or handling of the train leading up to the derailment.

The train was operating on the UP Twin Cities Service Unit, Estherville Subdivision, which is a single main track with a maximum authorized speed of 30 miles per hour (mph), as designated in the current UP Twin Cities Service Unit Timetable No. 4. There were no speed restrictions in effect for this train, or the track near the derailment area. As the train approached the accident area, the Engineer was seated at the controls on the south side of the lead locomotive, and the Conductor was seated on the north side of the same locomotive.

Approximately one mile prior to the point of derailment (POD), the track comes out of a 3-degree curve at Milepost (MP) 57.5. The track then remains tangent with an ascending grade of 0.20 percent to the POD. There are no structures or track components in the mile prior, and only one highway-rail grade crossing (HRGC), which is equipped with passive warning signs. The derailment occurred on tangent track at the west-end of a 152-foot open-deck timber bridge that spans Jack Creek.

The track, at this location, is constructed of 90-pound, continuous-welded rail (CWR) on wood crossties. It is fastened with cut-spikes and seated in 10-inch single shoulder tie plates. The overall condition of the ballast and geometry was compliant with all standards for this class of track. There are no rail joints in this portion and rail anchoring was also within standards, with no longitudinal movement in either direction. The overall tie conditions met minimal regulatory standards and were distributed well enough to maintain proper geometry.

Timetable direction for the Estherville Subdivision is east, and the geographic direction is southeast. Timetable direction will be used throughout this report.

At the time of the accident, it was dark and clear with a temperature of 11° F.

The Accident

The train was being operated eastbound at 28 mph, approaching the POD. According to the train crew, they did not observe or feel anything unusual prior to the derailment. The speed at the time of derailment was 28 mph. Both speeds, approaching, and at the time of derailment, were recorded by the event recorder of the lead locomotive, UP 5666.

While operating over the Jack Creek Bridge, the train experienced an undesired emergency application of the air brake system. The crew said they felt a surge and instantly saw a bright orange flash outside the locomotive cab coming from the explosion caused by the derailed cars.

Immediately following the emergency application, the Engineer contacted UP's Train Dispatcher in Omaha, Nebraska, by radio and told the Dispatcher they had experienced an undesired emergency brake application and appeared to have several cars on fire.

The Conductor walked back to investigate and found the train separated, with cars 1-20 on the rail separated from the rest of the train. The train crew feared the rail cars not derailed might also catch fire, so they moved cars 1-20 approximately one mile east of the POD.

The train crew said they met with first responders approximately 10-15 minutes after the accident and gave them a copy of the train consist with all hazardous material information and rail car placement. It was then decided to pull cars 48-100 back from the POD using the distributed power unit locomotive.

There were no fatalities or injuries due to the derailment and subsequent hazardous material release from the derailed cars. The Graettinger Fire Chief ordered an evacuation within a one-mile radius of the accident, which affected approximately seven people. The evacuation only lasted a few hours before it was determined safe to return.

There were 20 hazardous material cars that derailed, and 14 that released ethanol. The following is a list of the cars that released material:

Position from head-end	Car No.	Gallons released
21	DBUX 301674	14,693
22	TAEX 2893	26,630
23	TILX 199147	22,896
24	TCBX 198194	26,293
25	CTCX 732108	27,497
26	TILX 197694	28,896
27	DBUX 302834	28,886
29	TAEX 2909 [1]	28,922
30	WCHX 30078	28,926
31	WCHX 30098	19,422
32	TILX 199819	13,670
33	TILX 195202	28,923
34	CTCX 731383	28,921
36	CTCX 731997	28,908

Analysis and Conclusions

Analysis – Toxicological Testing: The Engineer and Conductor involved in this accident were tested under FRA's mandatory post-accident toxicological test requirements because this accident exceeded the $1 million-dollar major accident threshold. The test results obtained from FRA's Alcohol and Drug Control Program Manager were negative.

Conclusion: Toxicology did not contribute to the cause or severity of this accident.

Analysis – Locomotive Engineer Operating Performance: The lead locomotive was equipped with a speed indicator and event recorder as required. The recorder data was downloaded and analyzed by the National Transportation Safety Board (NTSB) work group at the accident site investigation, and the Locomotive Engineer was found to have complied with all applicable UP operating rules and train handling requirements.

Conclusion: Locomotive Engineer operating performance did not contribute to the cause or severity of this accident.

Analysis – Fatigue: The Federal Railroad Administration (FRA) uses an overall effectiveness rate of 77.5 percent as the baseline for fatigue analysis. At or above this baseline, FRA does not consider fatigue as probable for any employee. FRA obtained a 10-day work history for the Engineer and Conductor involved in this accident. Default software sleep settings and information from the fatigue-related questionnaires was used for each employee. Upon analysis of that information, FRA concluded fatigue was experienced by both crew members, but determined not to be a contributing factor.

Conclusion: Fatigue did not contribute to the cause or severity of this accident.

Analysis – Video: The two locomotives at the head-end of the train were both equipped with forward-facing cameras.

Conclusion: The video was viewed on-site and at NTSB headquarters in Washington, DC. Nothing appeared unusual on the video from the lead locomotive, UP 5666, at, before, or after the derailment. A large glare caused by the explosion as the train went into emergency could be seen.

Video from the second locomotive, UP 8376, is limited to what can be seen because of the lead locomotive blocking the view. When watching the video closely, a slight "jump up" can be seen along with what sounds like draw bars clanging at the west-end of Jack Creek Bridge near the POD. This could be caused by a slightly low bridge-end causing the train to ramp up.

Analysis – Hazardous Materials Shipper Information: Green Plains

Conclusion: Green Plains is an ethanol producer based in Omaha, Nebraska. It currently operates 17 ethanol plants located across the United States. The Superior, Iowa facility, on average, produces 130,000 to 165,000 gallons of ethanol per day depending on market conditions. On average, the plant originates two unit-train shipments of ethanol per month, each containing 80 to 112 tank cars.

Analysis – Consist Paperwork and Placards: The consist paperwork documented denatured ethanol, while the cars were equipped with placards indicating undenatured ethanol.

Conclusion:The consist paper work for the train had the description for the 98 hazmat cars as UN1987, Alcohols, N.O.S., Class 3, PG II, which describes denatured ethanol. However, placards displayed on all rail cars were for UN Identification Number 1170, signifying 200-proof ethanol. Green Plains at Superior, Iowa confirmed the product on the train was undenatured ethanol UN1170.

FRA recommended a violation against UP for accepting a train displaying different placards than what

was shown on the paperwork, an error that can greatly influence the emergency response plan. This incorrect information did result in some delay of proper response and planning, thus increasing the risk to responders, the public, and the environment.

Analysis – Walking Inspection of Train UEGKOT 09: A walking inspection of the two lead locomotives and cars 1 – 20 of the train on both sides.

Conclusion:A walking inspection on this portion of the train that made it over the POD revealed witness marks on 14 of the rail cars. The marks were all on the south side of the train, first showing up on the fourth car behind the locomotives. The marks could not be seen on every wheel because of how the wheels ultimately came to rest on the rail. Witness marks on rail wheels are deviations into the tread portion of the wheel that occur when the wheels encounter something very hard and blunt, and not the running surface of the rail.

The witness marks found during the inspection progressively got worse the further back from the head-end of the train the inspection extended. The marks on cars 19 and 20, both making it over the POD, exhibited two separate markings 11 ½ inches apart. This would suggest a second break occurred in the rail due to the initial break being repeatedly struck by rail wheels.

Analysis – Track, Bridge, Rail, and Geometry Car Inspections: FRA-required track inspection frequency for the Estherville Subdivision is two times per week for MP 0.0 – MP 32.2, and one time per week for MP 32.2 – MP 78.4.

- The track was last inspected by a hi-rail vehicle on March 9, 2017, the day before the derailment.
- The previous bridge inspection was preformed October 11, 2016.
- The last ultrasonic rail detection test through this area prior to the derailment was on July 14, 2016.
- The last geometry car survey prior to the derailment with a UP automatic track inspection vehicle was on August 15, 2016.

Conclusion: Track inspection records indicate that the track through the POD was inspected within the required frequency dating back to July 1, 2016. There were no defects recorded at or near the POD on these inspections, including the most recent hi-rail vehicle inspection conducted on the day before the derailment. For the week of February 19–25, 2017, only one inspection was made between MP 0.0 and MP 32.2. This portion of main track is listed as FRA Class 4 track, and requires a twice weekly inspection with one-day in between inspections.

FRA made a hi-rail inspection in each direction of derailment on March 10, 2017, to rule out any additional broken rails that could have occurred under the derailing train in the event of a flattened rail wheel. None were found. The FRA inspection east of the POD was from MP 54.53 to MP 49.09, while the inspection west was from MP 58.0 to MP 69.34. The portion in between those mileposts was not inspected because of equipment occupying the track.

An on-site walking inspection of the footprint of the derailment area included representatives from FRA, the NTSB, and Iowa's Department of Transportation, and was conducted from MP 57.10 to MP 56.35. A total of seven defects were identified, including five for tie conditions, and one each for rail fasteners and a concentrated load between the base of the rail and tie plate. This walking inspection found the overall surface condition to be consistent with applicable track standards. Periodic gage measurements were taken on both the curve and tangent track east of the POD, and no issues were found. There were no rail joints in this portion and anchoring was also within standards, with no longitudinal movement found in

either direction. Overall tie condition of the portion of the rail inspected met minimal regulatory standards and the ties were distributed well enough to maintain proper gage and geometry.

The bridge inspection frequency for the Jack Creek Bridge is two times annually. The previous bridge inspection did not reveal anything structural abnormalities with the bridge. The Bridge Inspector who last inspected Jack Creek Bridge is FRA-qualified under Title 49 Code of Federal Regulations (CFR) Section 213.7(b) to inspect track for defects. The UP Bridge Inspector did note that the first tie off the end of the Jack Creek Bridge at the POD had ballast leaking and was swinging 2 ½ inches. The Bridge Inspector stated in his interview that the track was supported, and he had found only the one tie swinging. The Bridge Inspector reported that nothing at Jack Creek Bridge was at or approaching defective condition when he made his inspection.

There were no rail defects found in the immediate area of the POD during the last UP ultrasonic rail test on July 14, 2016. The nearest defective rail, a vertical split head, found during that test was approximately five miles east of the POD.

There were no geometry defects found in the immediate area of the POD during the previous geometry car survey on August 15, 2016. The closest surface defect was a defective alignment found approximately one mile west of the POD.

Analysis – On-site Recovery of Rail: The investigation was primarily concerned with the recovery and identification of as much rail as was possible to recover.

Conclusion: The total displaced rail measured approximately 430 feet on each of the north and south side of the rails for a total of 860 linear feet. The on-site recovery found all but approximately four feet on the north rail, and 15 feet of the south rail.

The rail was identified by manufacturer and rail fracture characteristics. It was laid out in chronological order, organized as north and south rails.

Each piece of rail recovered was measured and uniquely marked from west to east as it would have laid in the track. There were 26 pieces recovered for the north rail and identified as 0N-25N. There were 16 pieces recovered for the south rail and identified as 0S-15S.

After gathering detailed information from UP on past ultrasonic rail detection data and bridge inspection GPS, inspectors could determine where the west Jack Creek Bridge-end was located. This allowed the investigation to reasonably determine where the recovered rail would have laid.

With this information, and the witness marks on the 14 rail cars at the head-end of the train, emphasis was placed on the south rail. Further focus was placed at any south rail near or on the west-end of Jack Creek Bridge. After careful measuring, it was determined that approximately 12.6 feet of rail was missing at this location.

Further investigation and measurements determined that rails recovered marked 9S, 10S, and 11S were the same rail section, and would include the 12.6 feet of missing rail. As a result, FRA requested that the NTSB include the rail marked 10S in the evidence sent to their materials laboratory in Washington, DC for further analysis.

Visual examination of all the rails recovered revealed that several pieces of rail exhibited head checks and shelling, including 10S.

Analysis – Lab Analysis of Rail: The NTSB forwarded 14 pieces of rail to their materials laboratory in Washington, DC for further evaluation. Included were nine from the north rail and five from the south rail,

including the section marked 10S.

Conclusion: The rails were examined using several different methods and will be documented in the NTSB's final report. None of the rail pieces examined were considered to contain the initial break that caused the derailment. FRA remained focused on the rail piece identified as 10S as most likely belonging to the suspect rail piece.

Several of the pieces, including 10S, were ultrasonically hand tested at the lab by a UP employee, with no defects found.

An angled flange mark was present on the running surface of the head of the rail piece marked 10S, beginning near the gage corner and falling off the field side. This type of deep mark generally means the rail was fully seated in its rail plates, thus fully supported at the time the flange marks were made. This may suggest 10S was very close to the actual suspect rail as the derailment happened. Using a method called optical metallography, the NTSB took a cross section of 10S and had it polished. When viewed under a microscope that was magnified 20 times, some shell cracks were present on the gage corner. This type of crack would not be detectable by an ultrasonic test, but is the type of crack that can eventually grow into "detail fracture" defects.

There was a defective head and web separation found on north rail sections numbered 10N and 11N. These both were examined and it was determined that, although these pieces were defective, they ultimately broke because of the derailment and were not the cause of the derailment. Wear was found to be minimal on all rail that was examined.

Overall Conclusions

UP was generally in compliance with their own and applicable FRA standards. FRA's investigation did result in a violation regarding the proper consist papers as a result of UP accepting a train displaying different placards than what was shown on the paperwork. There were also some minor track defects noted during inspections in both directions from the accident.

The data reviewed from the event recorder ruled out train handling as a cause of the derailment. There were no marks found on the rail or ties prior to the POD, which suggests nothing mechanical or track-related happened to the track prior to the POD.

Due to the witness wheel marks on the south side of the train, and because there were no rail joints in the area, it was determined that the probable cause of the derailment was a broken rail. While piecing together the recovered rail, it was determined that the largest area of missing rail, totalling12.6 feet, was located at the very end of Jack Creek Bridge at the suspected POD. After examining the piece of rail identified as 10S, it was determined this piece was at the very west-end of Jack Creek Bridge and would have been connected to the missing 12.6 feet. The physical examination of 10S showed shelling spots and head checking, both of which can cause detail fractures. This head checking was also consistent with the lab analysis of 10S.

Probable Cause and Contributing Factors

FRA's investigation determined the probable cause of the accident was Cause Code T207-Broken rail (detail fracture from shelling or head check). There was no contributing factor found for this accident.

[1] Car TAEX 2909 is represented in the accident sketch as GATX 203812. This is due to the only visible markings due to the damage to the car were the top stencil that was not covered when the car ownership changed and the car was re-stenciled. This car was built by GATX in 2007 and sold to Anderson Company in 2015 when it was re-stenciled to TAEX 2909. All required stencil markings and AEI tags were correctly TAEX 2909, but damaged and unreadable in the accident.