Federal Railroad Administration
Office of Railroad Safety
Accident and Analysis Branch

Accident Investigation Report
HQ-2018-1278

BNSF Railway (BNSF) Crude Oil Train Derailment
Doon, Iowa
June 22, 2018

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

Southbound BNSF Railway (BNSF) freight train U CPGSAP0 59T (the Train) derailed 35 loaded crude oil railcars on June 22, 2018, at 4:35 a.m., CDT. All times throughout this report are Central Daylight Time. The derailment occurred approximately a half-mile south of the city of Doon, Iowa, at Milepost (MP) 165.0, on the BNSF Twin Cities Service Unit, Marshall Subdivision.

No injuries were reported because of the derailment. The Lyon County Emergency Management ordered an evacuation of a 1-mile radius surrounding the derailment. The evacuation affected approximately 12 people, and lasted a few hours before it was determined safe to return.

In the derailment, 37 tank cars carrying hazardous materials were damaged. Thirty-five of the cars derailed, and 10 released a total of 162,018 gallons of crude oil. Track and signal damage was reported at $600,000, and equipment damage was $1,840,369.
At the time of the derailment, it was dawn, with cloudy skies and 59º F. The area had received approximately 5 inches of rain in a matter of hours, in addition to the higher than normal rainfall in the days leading up to the derailment. The culverts were completely submerged by flood water.

FRA's investigation determined the probable cause of the derailment was M103 – Extreme environmental condition — Flood.

U.S. Department of Transportation
Federal Railroad Administration

FRA FACTUAL RAILROAD ACCIDENT REPORT

FRA File #HQ-2018-1278

TRAIN SUMMARY

1. Name of Railroad Operating Train #1	1a. Alphabetic Code	1b. Railroad Accident/Incident No.
BNSF Railway Company	BNSF	TC0618105

GENERAL INFORMATION

1. Name of Railroad or Other Entity Responsible for Track Maintenance	1a. Alphabetic Code	1b. Railroad Accident/Incident No.
BNSF Railway Company	BNSF	TC0618105

2. U.S. DOT Grade Crossing Identification Number	3. Date of Accident/Incident	4. Time of Accident/Incident
	6/22/2018	4:35 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	37	10	12	Marshall

11. Nearest City/Town	12. Milepost *(to nearest tenth)*	13. State Abbr.	14. County
Doon	165	IA	LYON

15. Temperature (F)	16. Visibility	17. Weather	18. Type of Track
59 ˚F	Dawn	Cloudy	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-60, Passenger Trains-80	26.13	South

23. PTC Preventable	24. Primary Cause Code	25. Contributing Cause Code(s)
No	[M103] Extreme environmental condit	

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OPERATING TRAIN #1

1. Type of Equipment Consist:	2. Was Equipment Attended?	3. Train Number/Symbol
Freight Train	Yes	U CPGSAP0 59T

4. Speed (recorded speed, if available)	Code	5. Trailing Tons (gross excluding 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
R - Recorded E - Estimated 47.0 MPH	R	14075		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.)*	CTCX717908	7	yes		0	0
(2) Causing *(if mechanical, cause reported)*	N/A	0	no	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	101	0	0	0	0
(2) Total Derailed	0	0	0	0	0	(2) Total Derailed	35	0	0	0	0

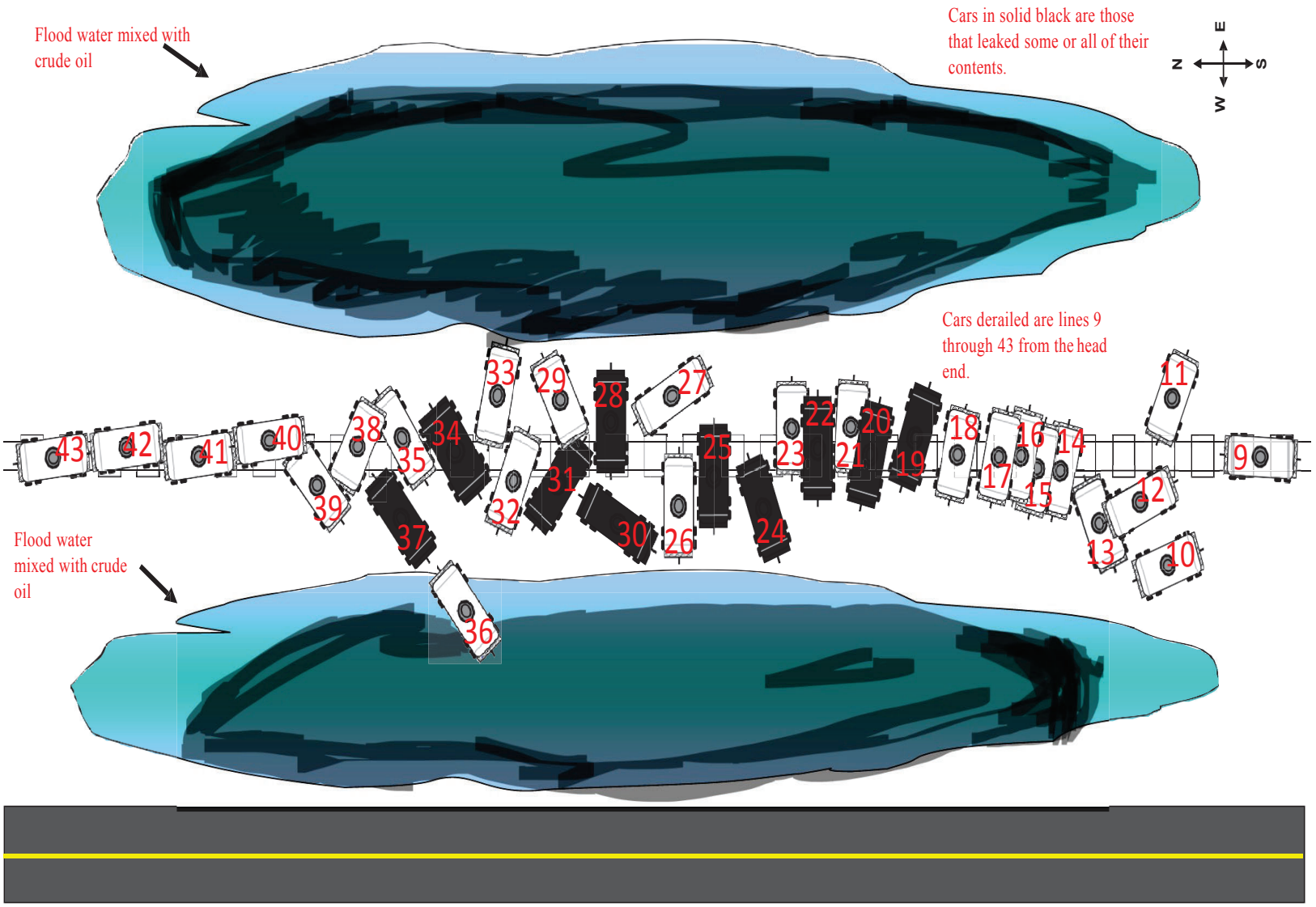
12. Equipment Damage This Consist	13. Track, Signal, Way & Structure Damage
1840369	600000

Number of Crew Members				Length of Time on Duty	
14. Engineers/Operators	15. Firemen	16. Conductors	17. Brakemen	18. Engineer/Operator	19. Conductor
1	0	1	0	Hrs: 5 Mins: 45	Hrs: 5 Mins: 45
Casualties to:	20. Railroad Employees	21. Train Passengers	22. Others	23. EOT Device? Yes	24. Was EOT Device Properly Armed? Yes
Fatal	0	0	0	25. Caboose Occupied by Crew?	N/A
Nonfatal	0	0	0		

26. Latitude	27. Longitude
43.258377000	-96.234582000

SKETCHES

Sketch - Accident Sketch



NARRATIVE

CIRCUMSTANCES PRIOR TO THE ACCIDENT

BNSF Railway (BNSF) freight train U CPGSAP0 59T (the Train) consisted of 2 locomotives on the head-end, 2 loaded buffer cars, 98 loaded tank cars containing crude oil, another loaded buffer car and 1 locomotive on the rear. The Train was 5,991 feet in length, with 14,075 trailing tons. All required tests and inspections were performed by qualified BNSF mechanical employees prior to the train departing Garretson, South Dakota.

On June 21, 2018, at 10:50 p.m., a crew consisting of an engineer and conductor went on duty in Sioux City, Iowa. Sioux City is the home terminal for both crew members, and both crew members received more than the statutory off-duty period prior to reporting for duty. The crew was assigned to taxi to Garretson and take the Train to Sioux City.

The Train departed Garretson at 3:10 a.m., with no scheduled work enroute to Sioux City. The trip was uneventful, with no issues reported by the crew prior to the derailment. The Train was traveling a recorded speed of 47 mph, with the engineer seated on the right (west) side of lead locomotive BNSF 9210, and the conductor seated on the left (east) side.

The derailment occurred on the BNSF Twin Cities division, Marshall subdivision, near Doon, Iowa. The Marshall subdivision is non-signaled, and the train operates by Track Warrant Control (TWC) issued by the BNSF train dispatcher in Fort Worth, Texas. The maximum authorized speed through the accident location is 49 mph, as designated in the current BNSF Twin Cities Service Unit Timetable No. 7. No speed restrictions existed for the Train or the track through the derailment area. Beginning at Milepost (MP) 164, the single main track is tangent with an ascending grade of 0.40-percent. A 594-foot open deck bridge is over the Little Rock River at MP 164.4, followed by a 2-degree, 38-minute curve at MP 164.5, and a highway-rail grade crossing at MP 164.7. The point of derailment (POD) was at MP 165, on tangent track, where two, 27-inch culverts are below the track to provide drainage between farm fields on both sides of the main track.

The track at this location is constructed of 136-pound continuous-welded rail on wood crossties. It is fastened with cut-spikes and seated in 14-inch double shoulder tie plates. The overall condition of the ballast and geometry was very good. No rail joints are in this area and rail anchoring was good with no longitudinal movement in either direction, and very good tie condition.

Both the timetable and geographical direction on the Marshall subdivision are south. Timetable direction will be used throughout this report.

At the time of the derailment, it was dawn, with cloudy skies and 59º F. The area had received approximately 5 inches of rain in a matter of hours, in addition to the higher-than-normal rainfall in the days leading up to the derailment. The culverts were completely submerged by flood water.

THE ACCIDENT

On June 22, 2018, at 4:35 a.m., the Train was traveling at MP 165, one-half-mile south of Doon, when an undesired emergency application of the air brake system took place.

Immediately following the emergency application, the Engineer contacted the Dispatcher by radio and told them that they had experienced an undesired emergency brake application and appeared to have several cars on the ground.

The Conductor inspected the train, and found the following damage:

Position in Train	Car Number	Derailed	Damaged	Releasing
7	CTCX 717908	No	Yes	No
8	CTCX 717988	No	Yes	No
9	CTCX 716627	Yes	Yes	No
10	CTCX 716595	Yes	Yes	No
11	CTCX 716597	Yes	Yes	No
12	CTCX 717975	Yes	Yes	No
13	CTCX 716611	Yes	Yes	No
14	CTCX 717790	Yes	Yes	No
15	CTCX 716879	Yes	Yes	No
16	CTCX 716615	Yes	Yes	No
17	CTCX 717098	Yes	Yes	No
18	CTCX 716959	Yes	Yes	No
19	CTCX 716781	Yes	Yes	Yes
20	CTCX 716860	Yes	Yes	Yes
21	CTCX 716641	Yes	Yes	No
22	CTCX 717997	Yes	Yes	Yes
23	CTCX 716965	Yes	Yes	No
24	CTCX 716898	Yes	Yes	Yes
25	CTCX 716624	Yes	Yes	Yes
26	CTCX 716527	Yes	Yes	No
27	CTCX 718010	Yes	Yes	No
28	CTCX 717904	Yes	Yes	Yes
29	CBTX 715942	Yes	Yes	No
30	CTCX 716530	Yes	Yes	Yes
31	CTCX 717805	Yes	Yes	Yes

32	CTCX 716735	Yes	Yes	No
33	CTCX 716526	Yes	Yes	No
34	CTCX 718011	Yes	Yes	Yes
35	CTCX 717905	Yes	Yes	No
36	CTCX 717933	Yes	Yes	No
37	CTCX 717041	Yes	Yes	Yes
38	CTCX 717809	Yes	Yes	No
39	CTCX 717926	Yes	Yes	No
40	CTCX 717837	Yes	Yes	No
41	CTCX 717932	Yes	Yes	No
42	CTCX 716841	Yes	Yes	No
43	CTCX 716675	Yes	Yes	No

The crew met with first responders at approximately 5 a.m., and provided a copy of the train consist, all hazardous material information and rail car placement.

No injuries were reported because of the derailment. The Lyon County Emergency Management ordered an evacuation of a 1-mile radius surrounding the derailment. The evacuation affected approximately 12 people and lasted a few hours before it was determined safe to return.

In the derailment, 37 tank cars carrying hazardous materials were damaged. Thirty-five of the cars derailed, and 10 released a total of 162,018 gallons of crude oil. Track and signal damage was reported at $600,000, and equipment damage was $1,840,369.

POST-ACCIDENT INVESTIGATION

FRA investigators analyzed physical evidence, took measurements, reviewed inspection and maintenance records, and interviewed those involved.

The below analysis and conclusions represent the findings of FRA's investigation.

ANALYSIS AND CONCLUSIONS

Analysis - Toxicological Testing: This derailment met the criteria for Title 49 Code of Federal Regulations (CFR) part 219, subpart C, *Post Accident Toxicological Testing*. Both train crew members were tested with negative results.

Conclusion: FRA determined drugs and alcohol did not contribute to the cause or severity of the derailment.

Analysis - Locomotive Engineer Operating Performance: The lead locomotive was equipped with a speed indicator and event recorder as required. The recorder data was downloaded by BNSF and

analyzed by FRA. The engineer had transitioned from light throttle, to idle, and then to light dynamic braking just prior to the derailment. No train brakes were applied to the train, and the transition from power to dynamic brake complied with applicable BNSF operating and train-handling rules. No exception was taken to the engineer's operating performance.

Conclusion: FRA determined the locomotive engineer operating performance did not contribute to the cause or severity of the derailment.

Analysis - Fatigue: 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 crew of the train. Default software sleep settings and information from the fatigue-related questionnaires was used for each employee. FRA concluded that fatigue was likely for the crew of the train; however, it determined any presence of fatigue would not have played a role in the derailment.

Conclusion: FRA determined fatigue did not contribute to the cause or severity of the derailment.

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

The video was viewed both on-site and in Fort Worth by FRA. The video from the lead locomotive, BNSF 9210, shows a void in the crib of the ballast at the POD. This void indicates that the washout had begun prior to this train's arrival, confirming the derailment was caused by the extreme environmental conditions (flooding).

Conclusion: FRA determined extreme environmental conditions (flooding) was the probable cause of the derailment. (M103 – Extreme environmental condition — Flood.)

Analysis - Car DOT Specification and Damage: All cars in the train are DOT specification 117R 100 W1. All cars had originally been built to CPC-1232 standards for DOT specification 111A 100 W1 and were retrofitted to meet standards for DOT specification 117R 100 W1 in 2014.

Multiple cars experienced sheared bottom outlet valve nozzles but only one car leaked from the bottom outlet valve. The low number of bottom outlet valve failures is being attributed to the new requirement for protection safety system to prevent unintended actuation during train accident scenarios on the Specification DOT 117. (Title 49 Code of Federal Regulations (CFR) 179.202-8).

Position in Train	Car Number	Loaded Volume	Released (gallons)	Recovered (gallons)
19	CTCX 716781	24,641	24,406	235

20	CTCX 716860	24,879	14,315	10,564
22	CTCX 717997	24,907	24,907	0
24	CTCX 716898	24,787	14,315	10,472
25	CTCX 716624	25,118	14,315	10,803
28	CTCX 717904	25,157	12,500	12,657
30	CTCX 716530	25,129	14,315	10,814
31	CTCX 717805	24,976	14,315	10,661
34	CTCX 718011	25,010	14,315	10,695
37	CTCX 717041	25,080	14,315	10,765

Conclusion: FRA determined car standards did not contribute to the cause or severity of the derailment.

Analysis- Track Maintenance: The FRA-required track inspection frequency for the entire Marshall Subdivision is two times per week, including the POD.

The track was last inspected by hi-rail vehicle on June 21, 2018, the day before the derailment.

The last geometry car survey prior to the derailment with a BNSF automatic track inspection vehicle was performed on June 19, 2018.

Track inspection records indicate that the track through the derailment area was inspected within the required frequency dating back to May 22, 2018. No defects were recorded at or near the POD on these inspections, including the most recent conducted on the day before the derailment.

The FRA and Iowa Department of Transportation (IDOT) Track Inspectors made a hi-rail inspection of the Marshall Subdivision in Region 6 to determine if any other culverts were possibly defective. These inspections found three defective conditions (two for pulled apart culverts and one for silting).

An on-site walking inspection that included FRA and IDOT inspectors was conducted one-half mile each direction from the POD to determine overall condition of the track structure. No defects were found and the track was in very good condition.

The BNSF bridge department does not inspect culverts under 36 inches unless something found by local track inspectors would warrant an inspection. No inspection reports had identified any issues with the 27–inch culverts at the POD prior to the derailment.
No rail defects were found in the immediate area of the POD during the last BNSF ultrasonic rail test.

No geometry defects were found in the immediate area of the POD during the previous geometry car survey.

Conclusion: FRA determined the track maintenance did not contribute to the cause or severity of the derailment.

OVERALL CONCLUSIONS

The railroad was generally in compliance with its own and applicable FRA standards.

While fatigue was probable for the crew of the Train, FRA determined the crew's actions could not have contributed to the cause or severity of the derailment.

FRA observed flood conditions, with water above the two 27–inch culverts, at the derailment location due to the heavy rainfall. Additionally, the void in the crib of the ballast visible on the locomotive camera indicates a washout condition existed at the POD. FRA determined the excess rain and flooding at POD caused the track bed to wash out, and was the probable cause of the derailment.

PROBABLE CAUSE AND CONTRIBUTING FACTORS

The FRA's investigation determined the probable cause of the derailment was M103 – Extreme environmental condition — Flood.