Federal Railroad Administration
Office of Railroad Safety
Accident and Analysis Branch

Accident Investigation Report
HQ-2015-1095

Canadian Pacific Railway Company (CP)
Watertown, WI
November 8, 2015

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.

U.S. Department of Transportation
Federal Railroad Administration

FRA FACTUAL RAILROAD ACCIDENT REPORT

FRA File #HQ-2015-1095

TRAIN SUMMARY

1. Name of Railroad Operating Train #1	1a. Alphabetic Code	1b. Railroad Accident/Incident No.
Canadian Pacific Railway Company	CP	HQ-2015-1095

GENERAL INFORMATION

1. Name of Railroad or Other Entity Responsible for Track Maintenance	1a. Alphabetic Code	1b. Railroad Accident/Incident No.
Canadian Pacific Railway Company	CP	1000299155
2. U.S. DOT Grade Crossing Identification Number	3. Date of Accident/Incident	4. Time of Accident/Incident
	11/8/2015	2:08 PM

5. Type of Accident/Incident
Derailment

6. Cars Carrying HAZMAT	7. HAZMAT Cars Damaged/Derailed	8. Cars Releasing HAZMAT	9. People Evacuated	10. Subdivision
108	15	1	41	Watertown

11. Nearest City/Town	12. Milepost *(to nearest tenth)*	13. State Abbr.	14. County
Watertown	131.2	WI	JEFFERSON

15. Temperature (F)	16. Visibility	17. Weather	18. Type of Track
50 °F	Day	Clear	Main

19. Track Name/Number	20. FRA Track Class	21. Annual Track Density *(gross tons in millions)*	22. Time Table Direction
Main Track No. 2	Freight Trains-40, Passenger Trains-60	50	East

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OPERATING TRAIN #1

1. Type of Equipment Consist:	2. Was Equipment Attended?	3. Train Number/Symbol
Freight Train	Yes	580-747

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
27 MPH	R	15412		0

6. Type of Territory

Signalization:

Signaled

Method of Operation/Authority for Movement:

Signal Indication

Supplemental/Adjunct Codes:

Q

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.)*	BRGX 951	81	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	0	(1) Total in Equipment Consist	110	0	0	0	0
(2) Total Derailed	0	0	0	0	0	(2) Total Derailed	15	0	0	0	0

12. Equipment Damage This Consist	13. Track, Signal, Way & Structure Damage
2143356	181500

14. Primary Cause Code

T299 - Other rail and joint bar defects (Provide detailed description in narrative)

15. Contributing Cause Code

T299 - Other rail and joint bar defects (Provide detailed description in narrative)

Number of Crew Members				Length of Time on Duty	
16. Engineers/Operators	17. Firemen	18. Conductors	19. Brakemen	20. Engineer/Operator	21. Conductor
1	0	1	0	Hrs: 5 Mins: 53	Hrs: 5 Mins: 53

Casualties to:	22. Railroad Employees	23. Train Passengers	24. Others	25. EOT Device?	26. Was EOT Device Properly Armed?
				Yes	Yes
Fatal	0	0	0	27. Caboose Occupied by Crew?	
Nonfatal	0	0	0		N/A

28. Latitude	29. Longitude
43.191213000	-88.736071000

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CROSSING INFORMATION

Highway User Involved		Rail Equipment Involved
1. Type		5. Equipment
2. Vehicle Speed *(est. mph at impact)*	3. Direction *(geographical)*	6. Position of Car Unit in Train
4. Position of Involved Highway User		7. Circumstance
8a. Was the highway user and/or rail equipment involved in the impact transporting hazardous materials?		8b. Was there a hazardous materials release by
8c. State here the name and quantity of the hazardous material released, if any.		

9. Type of Crossing Warning	10. Signaled Crossing Warning	11. Roadway Conditions
1. Gates 4. Wig wags 7. Crossbucks 10. Flagged by crew 2. Cantilever FLS 5. Hwy. traffic signals 8. Stop signs 11. Other *(spec. in narr.)* 3. Standard FLS 6. Audible 9. Watchman 12. None		

12. Location of Warning	13. Crossing Warning Interconnected with Highway Signals	14. Crossing Illuminated by Street Lights or Special Lights

15. Highway User's Age	16. Highway User's Gender	17. Highway User Went Behind or in Front of Train and Struck or was Struck by Second Train	18. Highway User

19. Driver Passed Standing Highway Vehicle	20. View of Track Obscured by *(primary obstruction)*

Casualties to:	Killed	Injured	21. Driver was	22. Was Driver in the Vehicle?
23. Highway-Rail Crossing Users			24. Highway Vehicle Property Damage *(est. dollar damage)*	25. Total Number of Vehicle Occupants *(including driver)*

26. Locomotive Auxiliary Lights?	27. Locomotive Auxiliary Lights Operational?

28. Locomotive Headlight Illuminated?	29. Locomotive Audible Warning Sounded?

10. Signaled Crossing Warning

1 - Provided minimum 20-second warning
2 - Alleged warning time greater than 60 seconds
3 - Alleged warning time less than 20 seconds
4 - Alleged no warning
5 - Confirmed warning time greater than 60 seconds
6 - Confirmed warning time less than 20 seconds
7 - Confirmed no warning
N/A - N/A

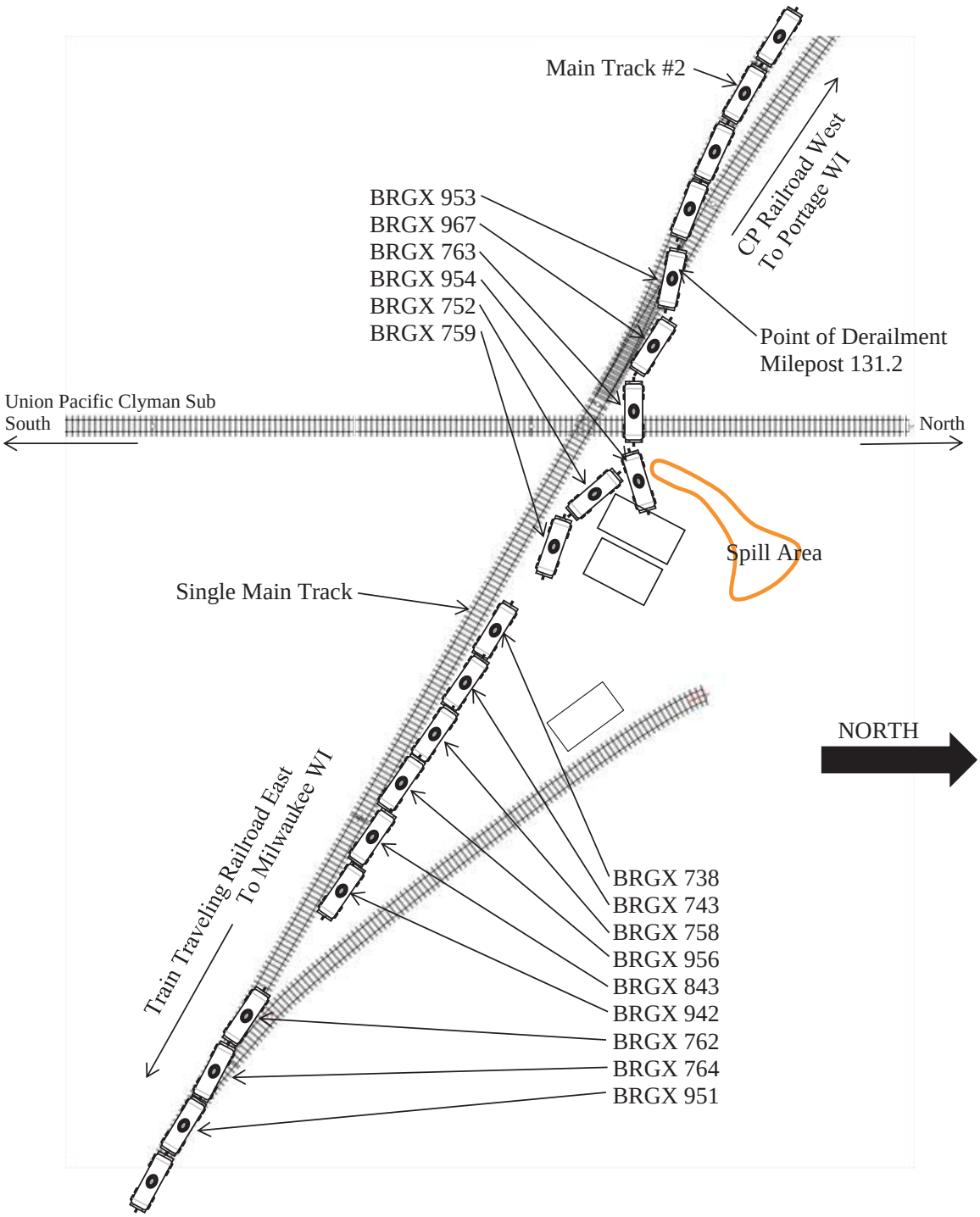
Explanation Code

A - Insulated rail vehicle
B - Storm/lightning damage
C - Vandalism
D - No power/batteries dead
E - Devices down for repair
F - Devices out of service
G - Warning time greater than 60 seconds attributed to accident-involved train stopping short of the crossing, but within track circuit limits, while warning devices remain continuously active with no other in-motion train present
H - Warning time greater than 60 seconds attributed to track circuit failure (e.g., insulated rail joint or rail bonding failure, track or ballast fouled)
J - Warning time greater than 60 seconds attributed to other train/equipment within track circuit limits
K - Warning time less than 20 seconds attributed to signals timing out before train's arrival at the crossing/ island circuit
L - Warning time less than 20 seconds attributed to train operating counter to track circuit design direction
M - Warning time less than 20 seconds attributed to train speed in excess of track circuit's design speed
N - Warning time less than 20 seconds attributed to signal system's failure to detect train approach
O - Warning time less than 20 seconds attributed to violation of special train operating instructions
P - No warning attributed to signal systems failure to detect the train
R - Other cause(s). Explain in Narrative Description

SKETCHES

Derailment Sketch

HQ-2015-1095: CP Derailment at Watertown, WI
Watertown Subdivision November 8, 2015



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SYNOPSIS

On November 8, 2015, at 2:08 p.m., CST, eastbound Canadian Pacific Railway (CP) Train Number 580-747 derailed 15 tank cars containing hazardous materials (Bakken crude oil) in Watertown, Wisconsin, at Milepost (MP) 131.2 on the CP Watertown Subdivision.

There were no injuries; however, there was a release of approximately 500 gallons of Bakken crude oil and a voluntary evacuation of 41 local residents. One of the derailed hazardous materials tank cars was breached which allowed product to leak onto CP-owned property.

The estimated total monetary damage was $2,143,356 to equipment and $181,500 to track and signal.

At the time of the accident, the weather was reported as sunny and clear. The temperature was 50 degrees Fahrenheit.

The Federal Railroad Administration's investigation determined the probable cause of the derailment was a broken rail in the turnout curved closure rail at MP 131.2. The broken rail was most likely caused by a detail fracture; however, due to post derailment damage, lab analysis tests were not conclusive.

NARRATIVE

Circumstances Prior to the Accident

The crew for Train 580-747 consisted of a locomotive engineer and a conductor. They reported for duty on November 8, 2015, at 8:15 a.m., CST, to CP's Yard Office in Portage, Wisconsin, to re-crew the unit Bakken crude oil train. The crew members received more than the statutory off-duty period prior to reporting for duty. The Engineer had been off-duty for 67 hours and 30 minutes prior to the assignment and the Conductor had been off for 13 hours and 30 minutes.

Train 580-747 initially consisted of one head-end locomotive, 108 loaded CPC-1232, non-jacketed tank cars with half height end shields, one loaded sand car at each end as a buffer, and one distributed power unit (DPU) at the rear of the train. The total length of the train was 6,679 feet with 15,412 trailing tons. The train received a Class 1 air brake test at New Town, North Dakota, at 3:30 a.m., on November 7, 2015.

Prior to departing Portage, the re-crewed Engineer and Conductor conducted a job briefing and checked the train's paperwork. The DPU was removed from the rear of the train, refueled, and then placed directly behind the lead locomotive at the head-end of the train. The crew performed a Class 3 air brake test and ensured that the two-way end-of-train device was operational.

Train 580-747 departed Portage in an eastbound direction on the Watertown Subdivision at 12:47 p.m., on November 8. The Timetable directions are east and west on CP's Watertown Subdivision. Timetable direction is used throughout this report. Immediately preceding the accident, the train was operating eastbound on Main Track Number 2 with signal indication in centralized traffic control (CTC) territory.

As Train 580-747 approached the accident area, the train was operated by the Locomotive Engineer who was seated at the controls on the right side of the cab facing forward. The Conductor was seated in the conductor's seat on the left side of the locomotive cab also facing forward.

The approach to Watertown, Wisconsin, from the west is double main track. At Watertown, the double main track ends at a switch at Milepost (MP) 131.2 just prior to the Union Pacific Railroad (UP) crossing-at-grade (diamond). To the east of Watertown is single main track.

On the approach to the derailment site from the west, the grade varies between 0.5 percent descending to flat for approximately 2.1 miles and is tangent until approximately 0.4 miles prior to the point of derailment (POD) where the track enters a 1.0-degree right-hand curve. At the POD, the train was operating through the turnout side of a number 16 turnout. The geometry at this location creates a slight S-curve in the track as the train negotiates the turnout traveling from Main Track Number 2 to single track. The track at the POD is generally flat until approximately 0.5 miles east of the POD where it becomes slightly ascending at 0.5 percent. The UP diamond is approximately 0.2 miles east of the POD.

The Accident

Train 580-747 was being operated at a recorded speed of 27 mph when the accident occurred. This speed was recorded by the event recorder on the trailing locomotive. The maximum authorized speed was 30 mph as designated in CP U.S. Southern Region Timetable Number 103.

After the lead locomotive traveled approximately 5000 feet past the switch at the Watertown Interlocking, Train 580-747 experienced an unintentional emergency brake application. The Engineer contacted CP's Wisconsin Dispatcher after not being able to recover the air and the Conductor began to walk back along the train to determine the cause of the emergency brake application. As the Conductor neared the end of the train it appeared that some of the cars were on their sides. He spoke to the Engineer and the dispatcher regarding what he could see via a hand-held radio. At about that same time, he heard sirens approaching the scene. Once the Conductor reached the derailment site, he encountered the Watertown Fire Department, which had been notified by a local resident, and he told them the train cars were loaded with crude oil.

A total of 15 cars derailed, positions 81 through 95 in the train consist, all of which were loaded crude oil tank cars. The first two cars re-railed themselves at the heel blocks of the POD switch, three derailed cars were still upright and ten cars were on their sides. One car was breached. The Watertown Fire Department applied foam fire retardant to the breached car and was able to apply a patch to the hole. Approximately 500 gallons of crude oil were released, but it did not enter any waterways and was contained to railroad property.

There was no fire or injuries due to the derailment; however, a total of 41 residents, from 35 homes north of the incident, were evacuated for approximately 48 hours as a precautionary measure by the Watertown Fire Department, Incident Commander.

Analysis and Conclusions

Analysis – Toxicological Testing: The accident met the criteria for Title 49 Code of Federal Regulations (CFR) Part 219 Subpart C, Post-Accident Toxicological Testing. The train crew members were tested under this authority. The test results for the two crew members were negative.

Conclusion: Impairment of the crew was not a causal factor in this accident.

Analysis – Fatigue Analysis of Train Crew Members: The Federal Railroad Administration (FRA) uses an overall effectiveness rate of 77.5 percent as the baseline for fatigue analysis, which is equivalent to blood alcohol content (BAC) of 0.05. At or above this baseline, we do not consider fatigue as probable for any employee. Software sleep settings vary according to information obtained from each employee. If an employee does not provide sleep information, FRA uses the default software settings.

FRA obtained fatigue-related information, including a 30-day work history, for two employees involved in this accident which were the Locomotive Engineer and Conductor assigned to the train.

Information for the train and engine service employees assigned to CP Train 580-747:

Fatigue Conclusions:

1. Locomotive Engineer: CP Train 580-747
Sleep setting - Excellent
Overall effectiveness = 91.29%
Lapse Index = 1.1
Reaction Time = 108%
Chronic Sleep Debt = 3.97
Hours of Continuous Wakefulness = 8.77
Time of Day 14:00
BAC Equivalent = >0.05
Finding: Fatigue was not probable for this employee.

2. Conductor: CP Train 580-747
Sleep setting - Excellent
Overall effectiveness = 89.68%
Lapse Index = 1.4
Reaction Time = 111%
Chronic Sleep Debt = 4.52
Hours of Continuous Wakefulness = 9.02
Time of Day 14:00
BAC Equivalent = <0.05
Finding: Fatigue was not probable for this employee

Finding: Fatigue was not probable for this employee

Conclusion: Upon analysis of the fatigue-related information, FRA concluded that fatigue was not probable for the two CP employees assigned to CP Train 580-747.

Analysis – Locomotive Engineer Operating Performance: FRA analyzed the event recorder data provided by CP's for the Trailing Locomotive NS 8163. CP was unable to obtain a download for the lead locomotive BNSF 9153 due to technical problems; however, the two locomotives were being utilized as a multiple-unit train control. It was determined the data would be nearly identical.

The maximum authorized speed at the derailment location was 30 mph. The lead locomotive was being operated using dynamic braking with gradual changes in throttle position until just prior to the derailment. The Engineer had just come out of dynamics and was beginning to gradually apply the throttle at the time of the unintentional emergency brake application. The train was traveling at 27 mph. The event recorder data prior to the derailment was consistent with proper train handling and no exceptions were taken.

Conclusion: Improper train handling was not a causal factor in this accident.

Analysis – Mechanical: A proper Class 1 air brake test was performed at 3:30 a.m., on November 7, 2015, by the mechanical department at New Town, North Dakota. After the crew rearranged the motive power, and prior to leaving Portage, a Class 3 air brake test was performed.
FRA Motive Power and Equipment (MP&E) Inspectors inspected Train 580-747's equipment after the derailment and found the following: four cars prior to the derailed cars, positions 80 through 83, had significant fresh strike marks on the wheels which indicate that they most likely encountered a broken rail. Based on significant flange damage, it was determined that the first two derailed cars were the BRGX 951 (position 81) and BRGX 764 (position 82) but re-railed themselves at the heel blocks of the switch points. This contributed to damaged flanges on those cars and destroyed heel blocks.

FRA MP&E Inspectors found no evidence of equipment defects that had occurred prior to the accident.

Conclusion: The mechanical condition of the equipment was not a causal factor in this accident.

Analysis – Track Structure: Track measurements taken after the derailment showed the track geometry to be in compliance for the class of track. FRA's post-accident inspection of the track noted no FRA Part 213 deficiencies approaching the POD. In addition to the number 16 turnout and UP diamond that were destroyed, approximately 1,000 feet of track was damaged. The turnout had catastrophic damage in the closure rail area, and there was evidence that cars were re-railing themselves as they were pulled through the heel blocks of the switch.

The last track inspection was performed by a qualified CP track inspector on November 6, 2015, and no defects were noted. Track on this portion of the Watertown Subdivision is inspected three times per week which exceeds the FRA's minimum requirement of twice weekly.

The last CP geometry test car operated over this portion of the Watertown Subdivision on September 23, 2015, and no defects were noted. CP operates its geometry car over the Watertown Subdivision at approximately 120-day intervals.

The last ultrasonic rail flaw detection test was conducted on September 23, 2015, and the nearest rail flaw was approximately 0.1 miles west of the derailment location. It was a shelling, spalling and/or corrugation (SSC) defect located at MP 131.345 on Main Track Number 2. This defect had been removed from the track on November 5, 2015. CP conducts ultrasonic rail flaw detection tests at approximately 60-day intervals.

The track leading up to the derailment site was constructed of wood crossties spaced at approximately 20-inch centers, box anchored every other tie with 132-pound continuous-welded rail (CWR). West of the POD, approximately 0.1 miles, there was a switch on Main Track Number 2 that was constructed with wood ties and conventional cut spikes. The north rail for the switch was 132 pounds and the south rail was 136 pounds. Every tie was fully box anchored and there was little evidence of rail movement.

The switch that the derailment occurred on was a number 16 left-hand turnout constructed with wood ties, conventional cut spikes and 132-pound rail. It too was fully box anchored . Most of this rail was identified as 132 25 RE, BC BSC Workington manufactured in July, 1987. The north curved closure rail was identified as 132 25 RE, CC USS Illinois manufactured in October, 1978. The POD was located in this rail approximately 64 feet and 6 inches west of the right-hand switch point. A 60-inch long section of rail that contained the suspect POD fracture, along with two other fractured rail pieces that matched the POD, were delivered to CP's rail analysis laboratory on November 16, 2015. The rail had 1/8-inch vertical wear and 1/8-inch gage face wear. The rail was examined visually, ultrasonically and by Magnaglo (fluorescent magnetic particle inspection).

Test results determined that the secondary pre-existing detail fractures (DF) detected by ultrasonic and Magnaglo inspections in the POD rail section suggest that the transverse breaks on both ends of the rail may have been nucleated by pre-existing DF's at these locations; however, heavy polishing at both fractured ends obscured any features on the fractured surfaces. The apparent DF's on both ends of the suspected POD rail would have acted as a stress raiser and promoted the nucleation of brittle fractures. The brittle fractures continued through the remainder of the rail's cross-section severing the rail in two when a load exceeded the diminished strength which subsequently caused the derailment. In addition, ultrasonic and Magnaglo inspections conducted on the POD rail section confirmed the presence of three other DF's along the rail section. These DF's were between 5 and 10 percent in size, and given that the last ultrasonic rail flaw detection test had occurred 45 days prior to the derailment, they would most probably not had been discovered during that test.

Conclusion: A broken rail caused by a detail fracture is the probable cause of the accident.

Analysis – Signal: The area of the derailment was CTC territory. FRA analyzed the signal system test records for the Watertown Interlocking. No deficiencies were noted in CP testing of its' signal system at the derailment location.

Conclusions: Signal equipment was not a causal factor in this accident.

Analysis – Tank Car Performance: All 15 of the tank cars involved in the derailment were CPC-1232, non-jacketed tank cars with half height-end shields. The BRGX 954 tank car was breached as a result of the derailment and released approximately 500 gallons of its contents. The other 14 derailed cars retained their entire lading. All of the cars contained Petroleum Crude Oil, Class 3, UN 1267, PGI.

Of the 15 derailed cars, 13 sustained varying degrees of damage to the head shields and safety appliances. Two cars, BRGX 967 and BRGX 942, were transported to Transportation Technology Center Inc. in Pueblo, Colorado, for further testing of their safety performance.

Conclusion: The loss of product came through a puncture in the bottom of BRGX 954.

Analysis – Environmental: An estimated 500 gallons of crude oil spilled onto the ground at the site of the derailment. A temporary dike was constructed to contain the product, and a vacuum truck was on site to collect the product as it pooled. Remediation of the contaminated soil began as soon as the pooled product was removed. Approximately 650 cubic yards of soil was removed and transported to a licensed landfill in Racine, Wisconsin, for disposal.

Conclusion: No long-term or permanent environmental impacts occurred as a result of this accident.

Probable Cause and Contributing Factors

Overall Conclusion: The FRA's investigation determined the probable cause was a broken rail as a result of a detail fracture in the turnout north curved closure rail at MP 131.2.