Learnings from Twenty Years of Canadian Track-Caused Derailment Investigations

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Learnings from Twenty Years

- **Agenda**
  - **The TSB of Canada**
  - **Safety Occurrences**
  - **Broken Rail**
  - **Wide Gauge**
  - **Track Buckles**
  - **Weather, Spring Thaw, Training**
  - **Increased Tonnage Risk**
  - **Progress Made and Outstanding Opportunities**

The Transportation Safety Board of Canada

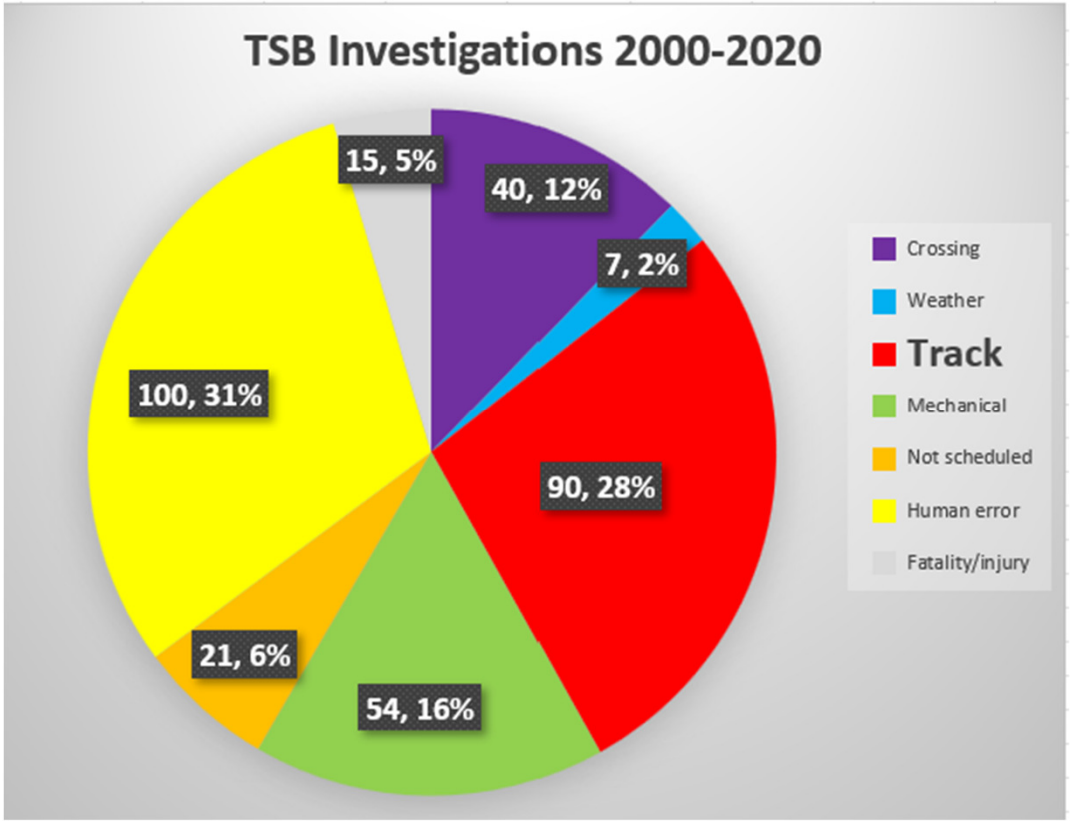
- **The Transportation Safety Board of Canada is an independent federal agency that advances transportation safety by investigating occurrences in the air, marine, pipeline and rail modes of transportation.**
- **TSB selects and attends a sample of concerning train derailments to establish cause.**
- **Publicly available reports are generated by the TSB. These reports identify the factors that caused or contributed to the occurrence, and the safety deficiencies that needed to be addressed.**

The Transportation Safety Board of Canada

- **The TSB follows up on recommendations designed to eliminate or reduce safety deficiencies found during the investigations.**
- **The TSB does not have the mandate or authority to implement specific corrective actions. Such actions are taken by regulatory agencies, manufactures and operating companies.**

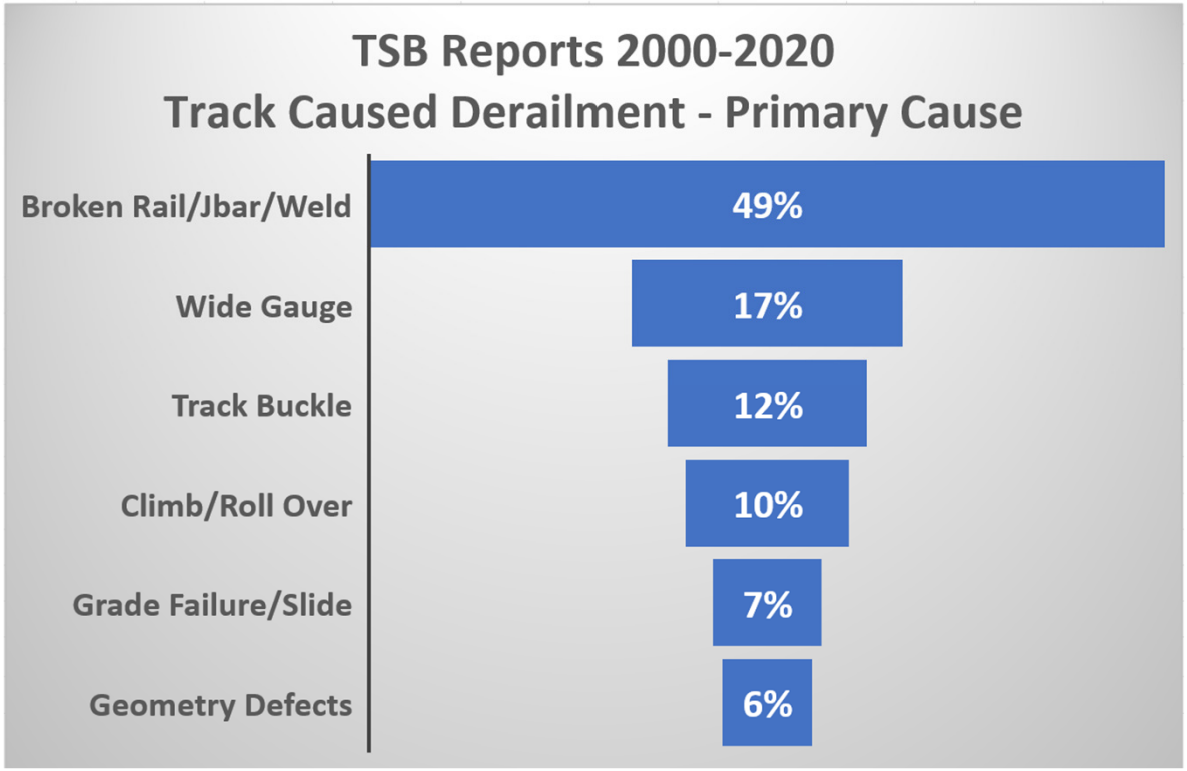
Safety Occurrences

- 327 derailments investigated by the TSB between 2000 and 2020
- 90 derailments where a track issue was determined to be the primary cause.



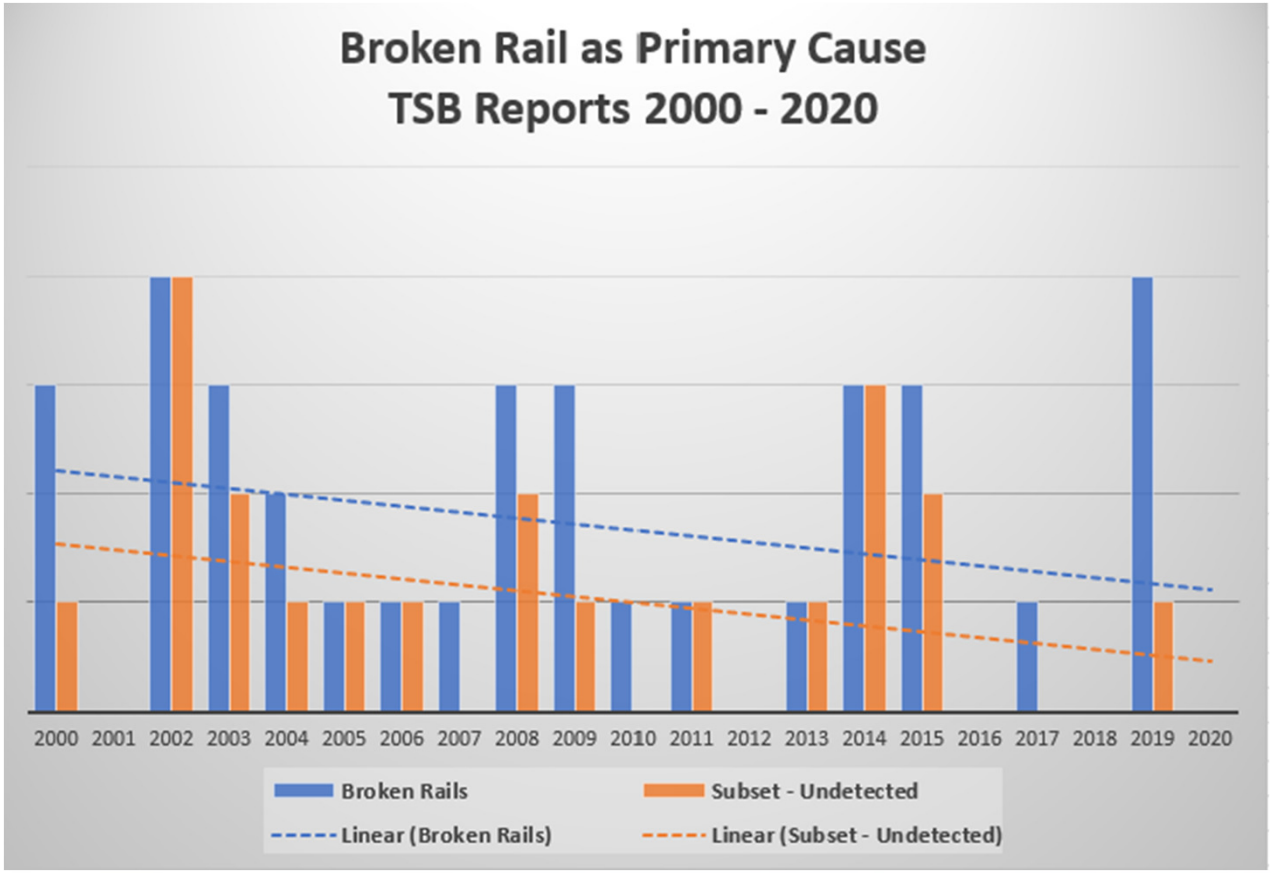
Safety Occurrences

- **Majority of the derailments attributed to three causes;**
  - **Broken rail, joint bar, weld**
  - **Wide Gauge**
  - **Track Buckle**



Broken Rail

- **35 derailments investigated with broken rail as a primary cause.**
- **Reports suggest that 21 derailments resulted from undetected internal flaws.**
- **A majority of these were prior to 2015.**



Broken Rail

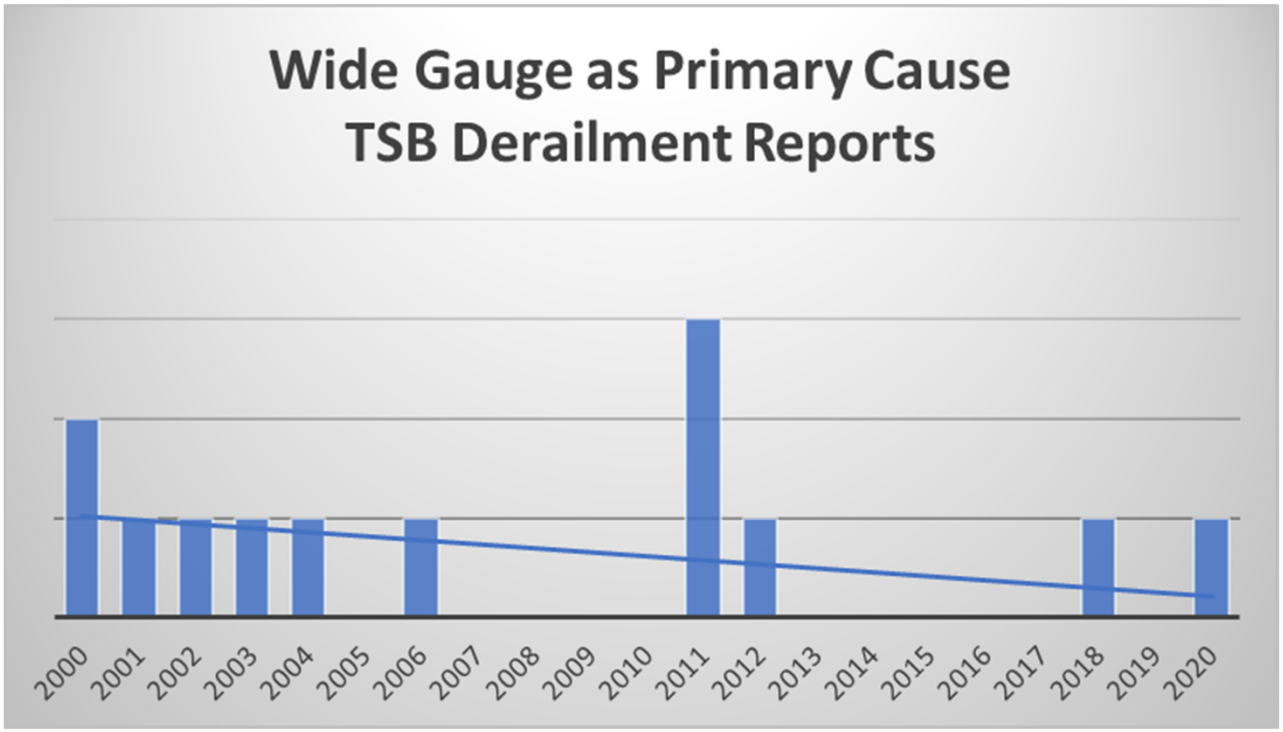
- **Broken rails have been a focus of the TSB since 1994 when "A Special Study of Main Track Derailments" was released. The study concluded;**
  - **Main track derailments had decreased by a factor of 3 between 1980 and 1988 while the number remained the same between 1988-1993.**

Broken Rail

- Reasons for the decline included;
  - Improved Installation and repair of CWR.
  - Increased use of automatic rail defect detection and track geometry measurement technology.
- Further technology advancements in internal rail defect detection was expected to reduce the number of broken rails.

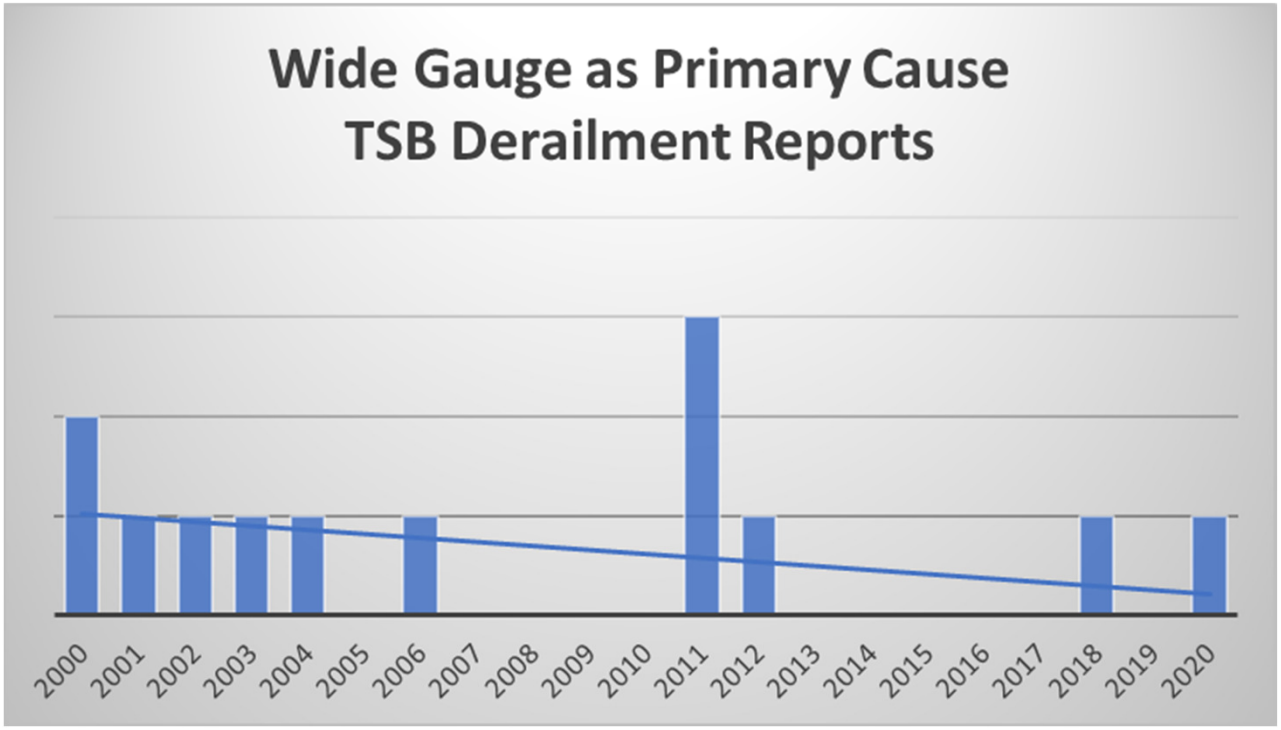
Wide Gauge

- **Within the TSB data, 13 derailments with wide gauge as primary cause.**
- **Of these, 8 reports show poor tie condition as a root cause, while 5 show inadequate or poor inspection practices as a root cause.**
- **85% of wide gauge derailments occurred in 2012 or earlier.**



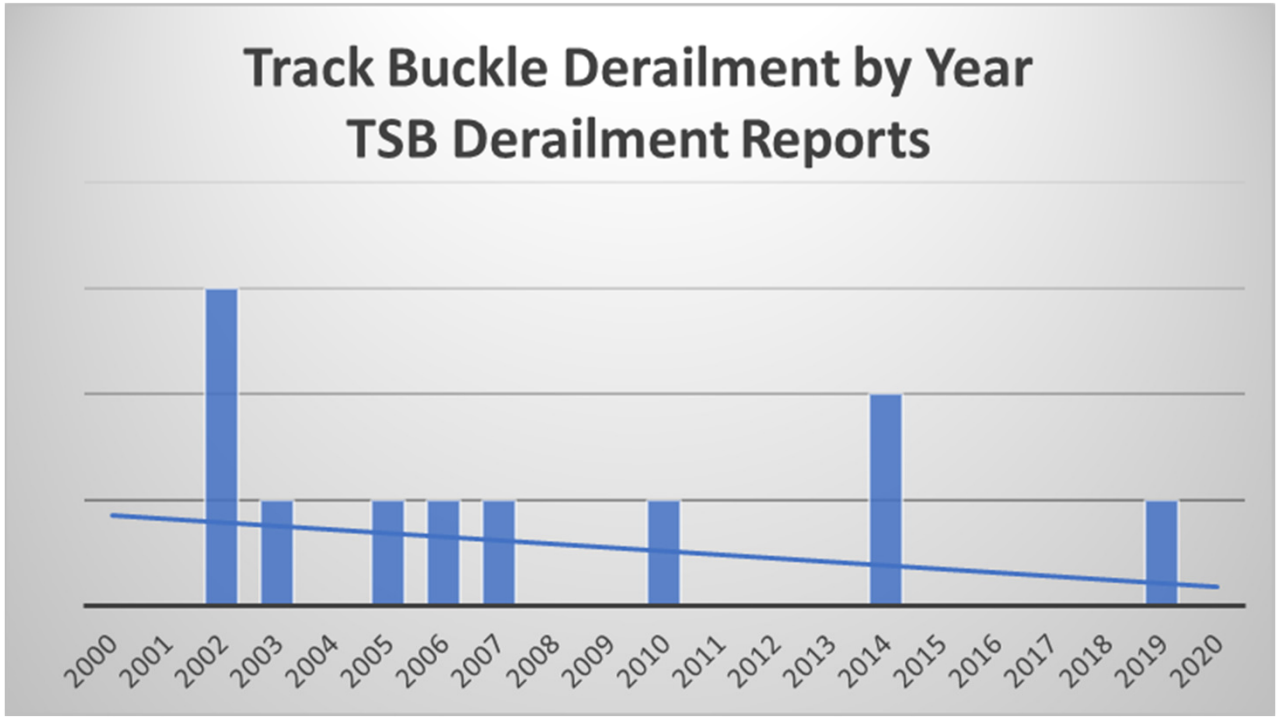
Wide Gauge

- **The 2012 revision of Transport Canada's "Rules Respecting Track Safety", had an impact on the number of wide gauge derailments.**
- **That revision required heavy or light geometry testing which resulted in identification of problematic gauge areas.**



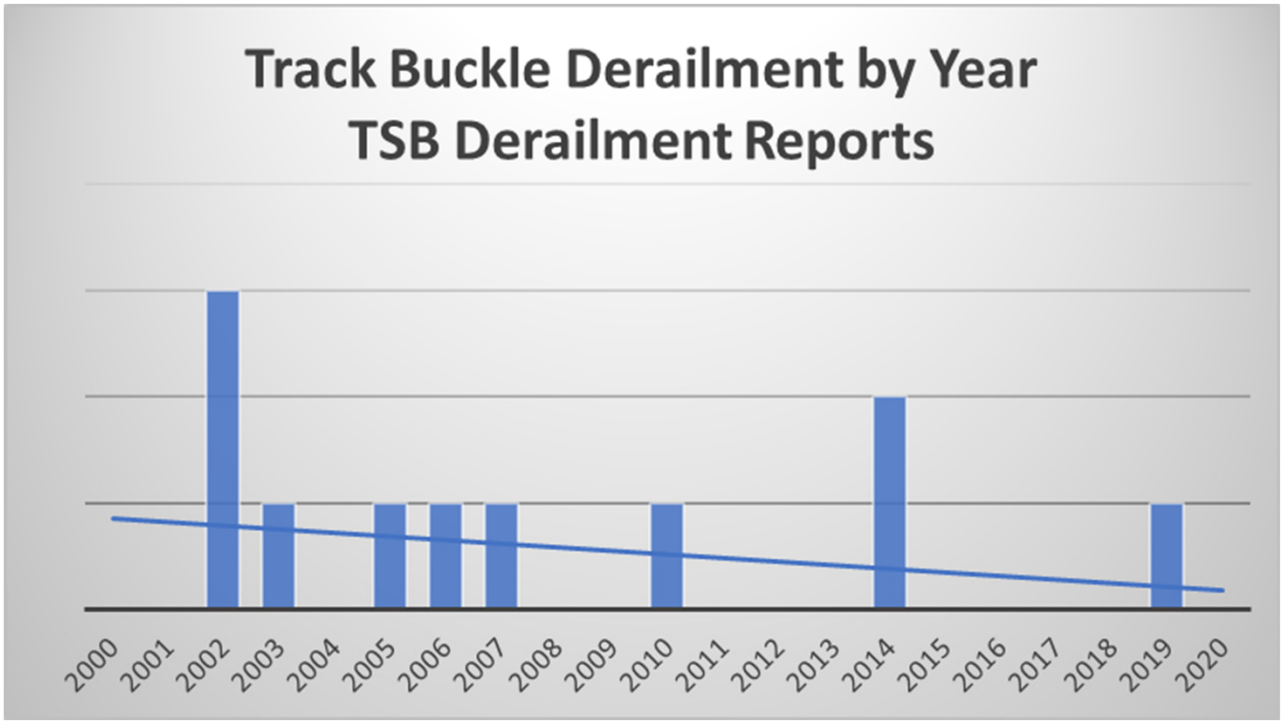
Track Buckles

- TSB data shows 11 derailments with a track buckle as a primary cause.
- 7 of these derailments had track work being performed or just performed prior to the derailment.
- Insufficient or inadequate anchors and poor tie condition were also present.



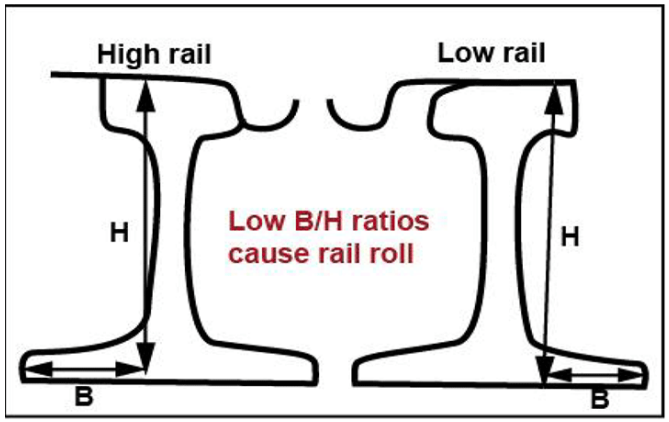
Track Buckles

- **The TSB issued Rail Safety Recommendation R93-03 in February 2003 concerning destressing of CWR.**
- **In 2011 Transport Canada confirmed to the TSB that both CP and CN had established standards for destressing of CWR.**



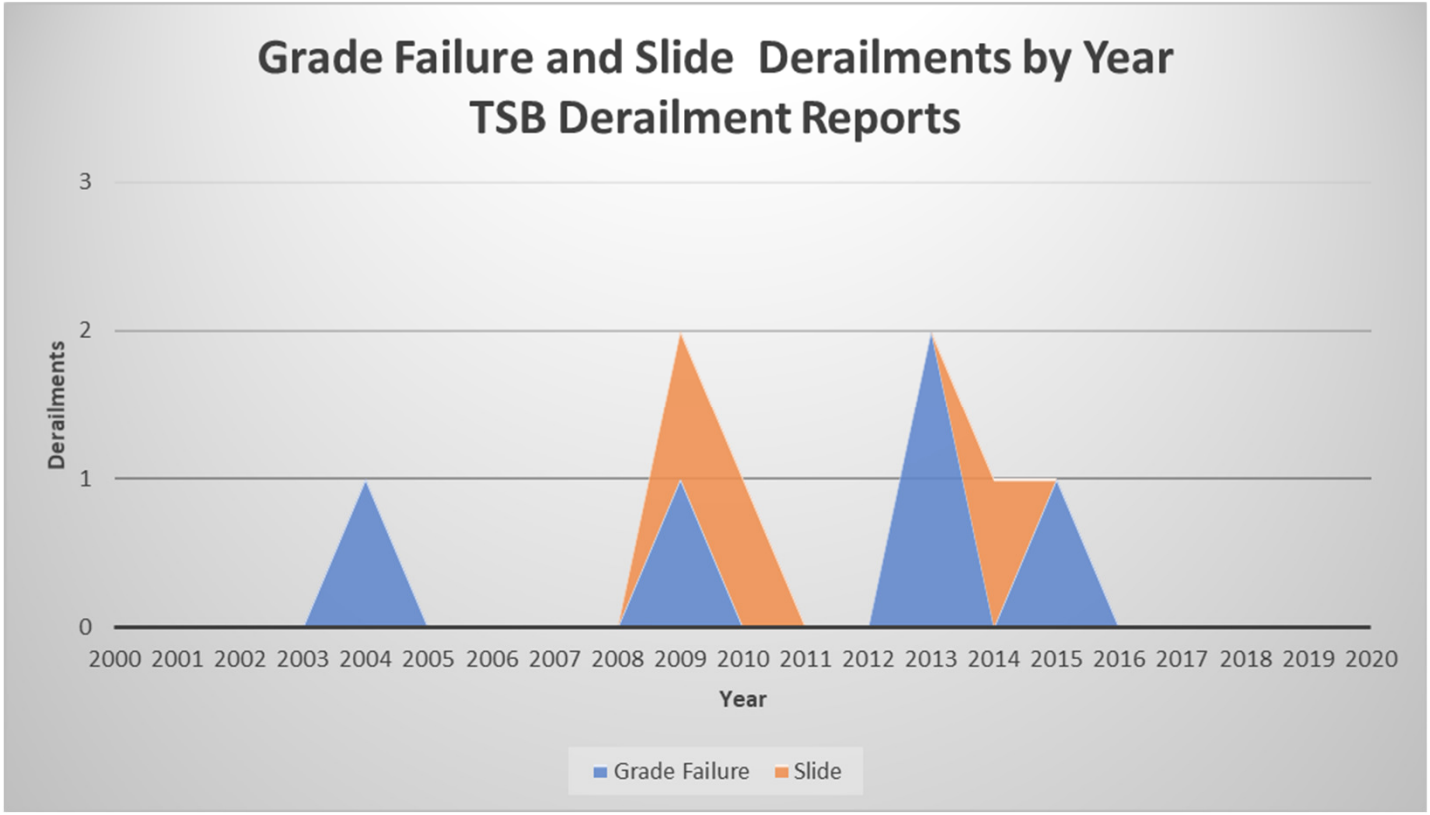
Rail Rollover

- 6 derailments were investigated by TSB that had rail rollover as primary cause between 2000 and 2020.
- Poor tie condition and train handling was noted in 3 derailments, high L/V in 2 derailments, binding truck in 1 derailment.
- Truck performance detectors have been installed on CN and CP
- Both railways have evaluated actual speeds on curves to reset superelevation to match speeds at which a majority of trains operate.
- Active rail profile grinding programs help manage L/V.



Geotechnical

- **Five grade failures and three slides were investigated in the twenty year period.**

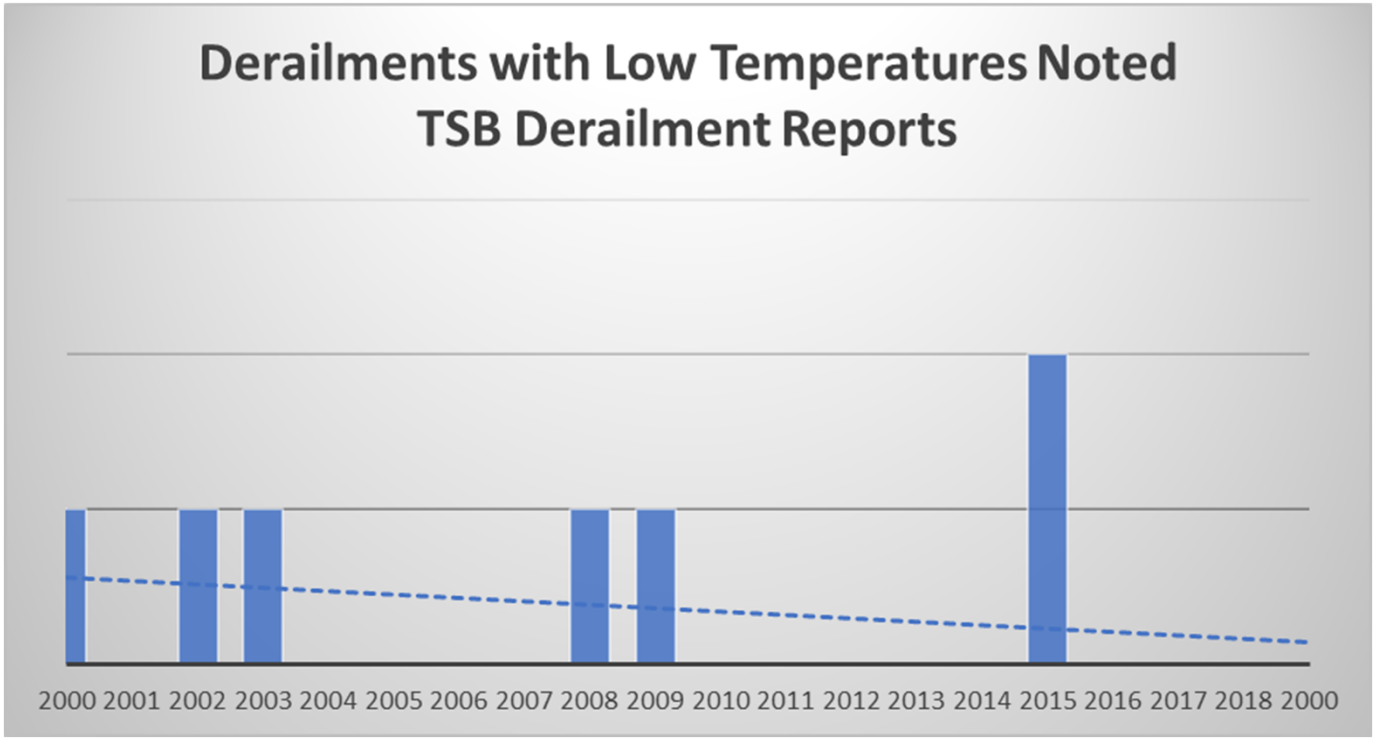


Geotechnical

- In 2003, Transport Canada along with CN and CP created the Railway Ground Hazard Research program. This program is a collaborative effort to develop and evaluate scientific and technical solutions to help railway manage the risks associated with ground hazards.
- It is fairly certain without this work, the outcome severity of ground hazard events would have been significantly worse.

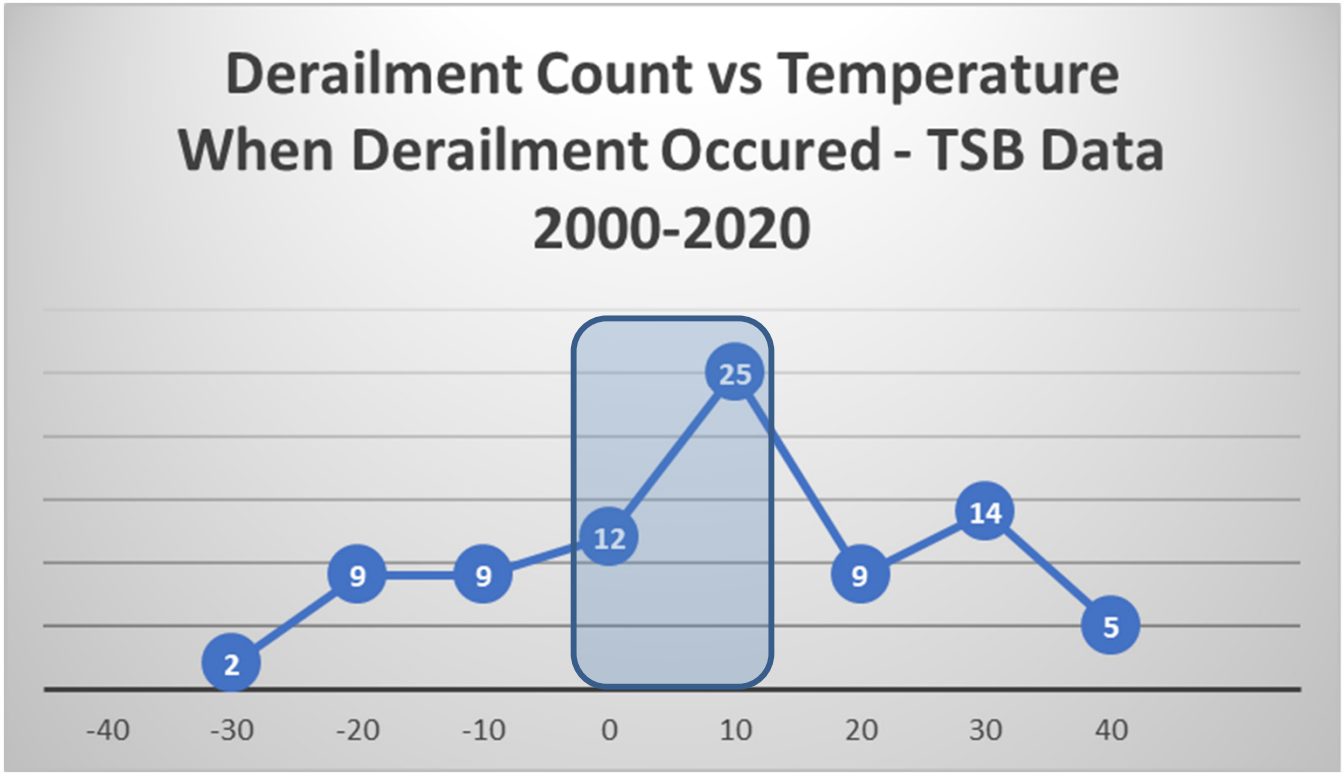
Weather

- There are seven derailment reports that show the derailment occurred when low temperatures were present.
- Not very enlightening



Weather

- **The data shows more derailments occurred between 0C and +10C as compared to more extreme temperatures.**



Weather

- Similar to hot and cold temperature track patrols, both CN and CP have put in place procedures for inspections during spring thaw and high water events.
  - CN Spring Readiness Inspections
  - CP Red Book of Track and Structures

Training

- TSB expressly states that it is not the function of the Board to assign fault. The reports are silent on a particular inspector's ability.
- A review of the 90 track caused derailments suggests that training was a root cause in 12.
- TSB reports show subsequent actions by the railway in 5 derailments resulted in additional or new training.

Increased Tonnage Risk

- In 2006, TSB undertook a Safety Issue Investigation (SIIR05) of broken rails during the winter of 2003-2004. TSB felt there was a relationship between the occurrence of rail defects and the level of bulk traffic. TSB also commented on the sufficiency of the RRTS to consider the effects of overall increased traffic.
- Subsequently there were two revisions to the RRTS, in 2008 and then again in 2012. The 2012 version incorporated line tonnage as a consideration for inspection frequency.

Increased Tonnage Risk

- **A review of the 90 TSB reports suggest that 11 derailments may have been mitigated by additional visual inspections triggered by line tonnage increases. Of note, 8 of these derailments occurred prior to the last revision of the RRTS in May 2012.**

Signs of Progress

- **Tighter rail detection intervals, in particular when facilitated with non-stop ultrasonic rail flaw detection, have improved internal rail defect detection.**
- **Track geometry inspection frequencies, in particular when facilitated by autonomous track geometry cars, have reduced mainline track geometry related incidents.**
- **Gauge restraint measurement systems have enabled better targeting of tie clusters that can lead to wide gauge.**

Signs of Progress

- Light geometry inspection vehicles have extended derailment protection into lower tonnage lines, particularly in reducing wide gauge incidents.
- There is an increased understanding of the importance of rail destressing.
- Hot and cold weather protocols have reduced incidents related to weather extremes.

Outstanding Opportunities

- Can disturbed track risks be better identified in advance of the work?
- Are targeted rail neutral temperatures striking the right balance between the frequency and consequences of track buckles vs. broken rails?
- Can improved understanding of geotechnical and water management hazards outpace increased extreme weather occurrences?

Outstanding Opportunities

- Is mentoring and quality control of manual visual inspections more effective than training?
- Should inspections be more frequent when tonnage increases rapidly on jointed track?
- Can combination track geometry defects be better defined?
- Can the risk of rolling contact fatigue manifestations be identified better?

Some Opportunities Are Incorporated into the 2022 Version of Transport Canada's *Rules Respecting Track Safety*

- Defines maximum time intervals between rail flaw detection tests by tonnage and track class
- Defines track geometry test cycles for light and heavy track geometry vehicles.
- Requires auditing of safety-critical track inspection and maintenance activities.
- Requires professional engineer sign off of CWR management plans.

Some Opportunities Are Incorporated into the 2022 Version of Transport Canada's *Rules Respecting Track Safety*

- **Requires cold weather speed restriction protocols on key routes.**
- **Requires defined procedures for dealing with the consequences of rolling contact fatigue.**
- **Requires combination defects to be defined for lines carrying tank cars and covered hoppers.**

Future State?

- **Better integration of automated inspections and manual visual validation and follow-up, in place of bi-weekly visual inspections.**
- **Inspection regime tailored to the risk profile of the combination of track condition, inspection capabilities and traffic mix.**
- **Continuous lowering of the vehicle/track interaction stress state.**
- **Escalation of maintenance and renewal action based upon predictive algorithms.**