



# How UAS technology supports the modern railroad network

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# Overview





# Corridor and gateway



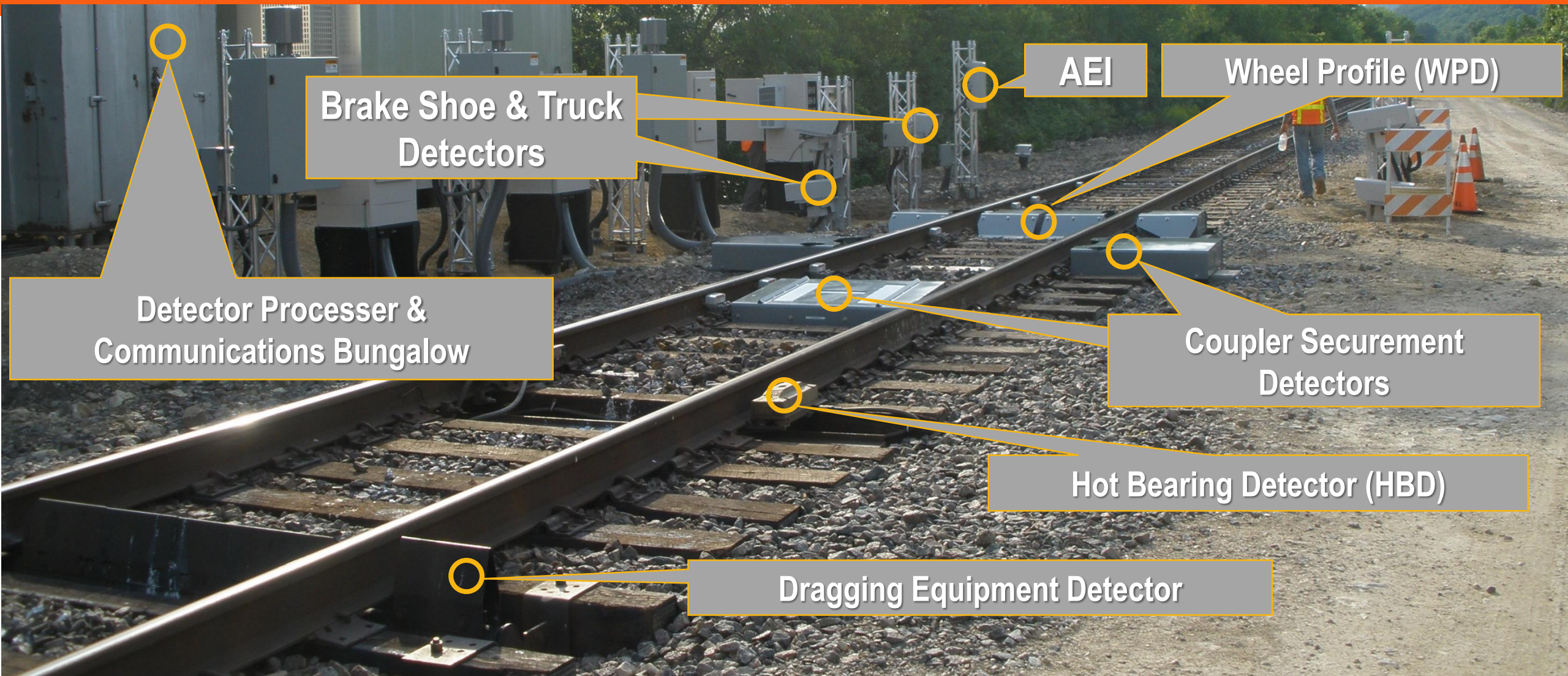
- 32,000 miles of track
- 28 Western states, 2 Canadian provinces
- Serves 40+ ports, 30+ intermodal facilities
- Averages 1,600 trains/day
- Last yr.: more than 10 million carloads

# Network Operations Center





# Wayside detectors

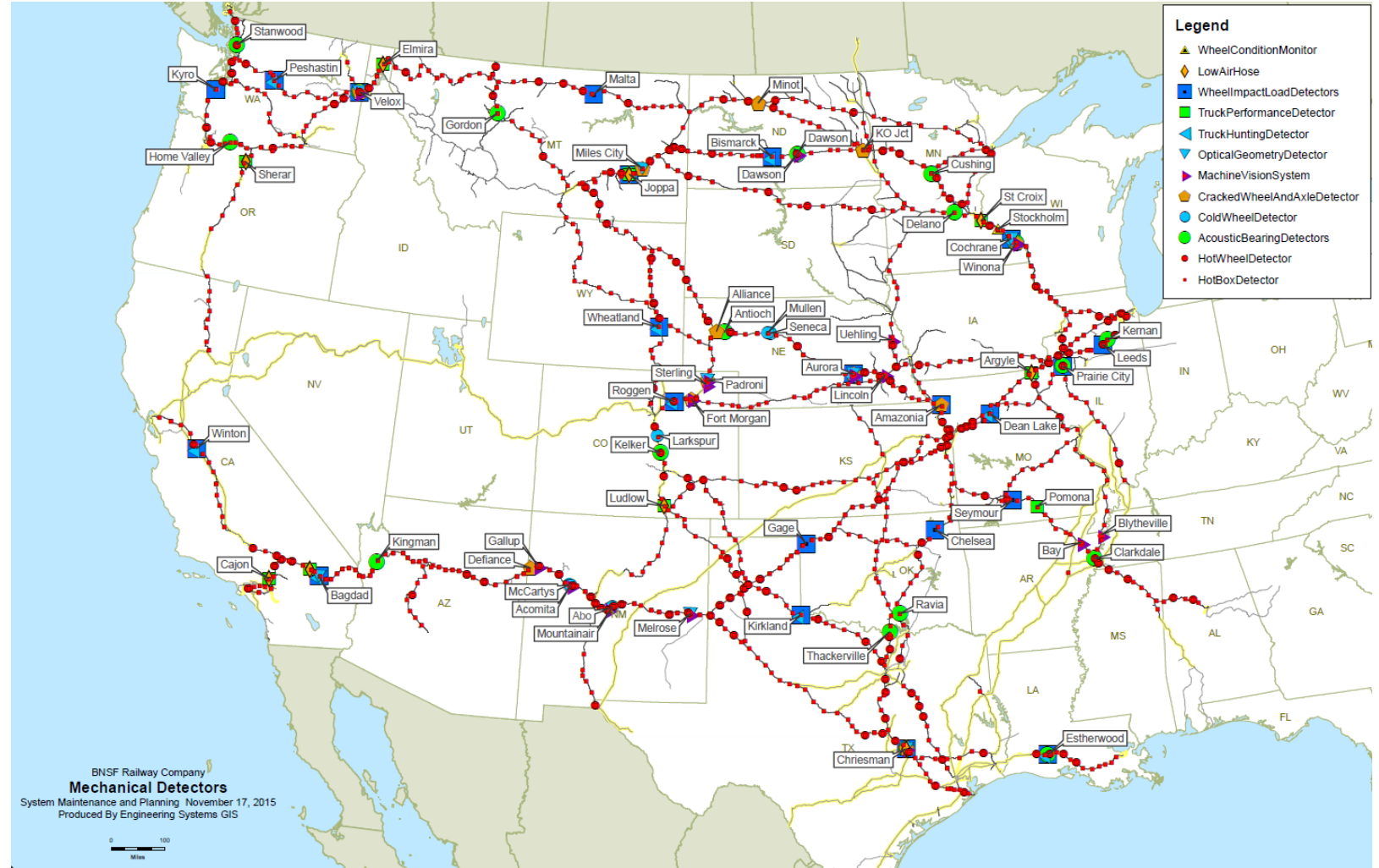




# Detector network

## Prevention Technology

- Hot Box Detector (HBD)
- Wheel Impact Load Detector (WILD)
- Acoustic Bearing Detector (ABD)
- Sonic Cracked Wheel/Axle Detector (CWAD)
- Machine Vision Systems
- Optical Geometry Detector (OGD)
- Warm Bearing Detection System (WBDS)
- Hot Wheel Detectors (HWD)
- Truck Performance Detectors (TPD)



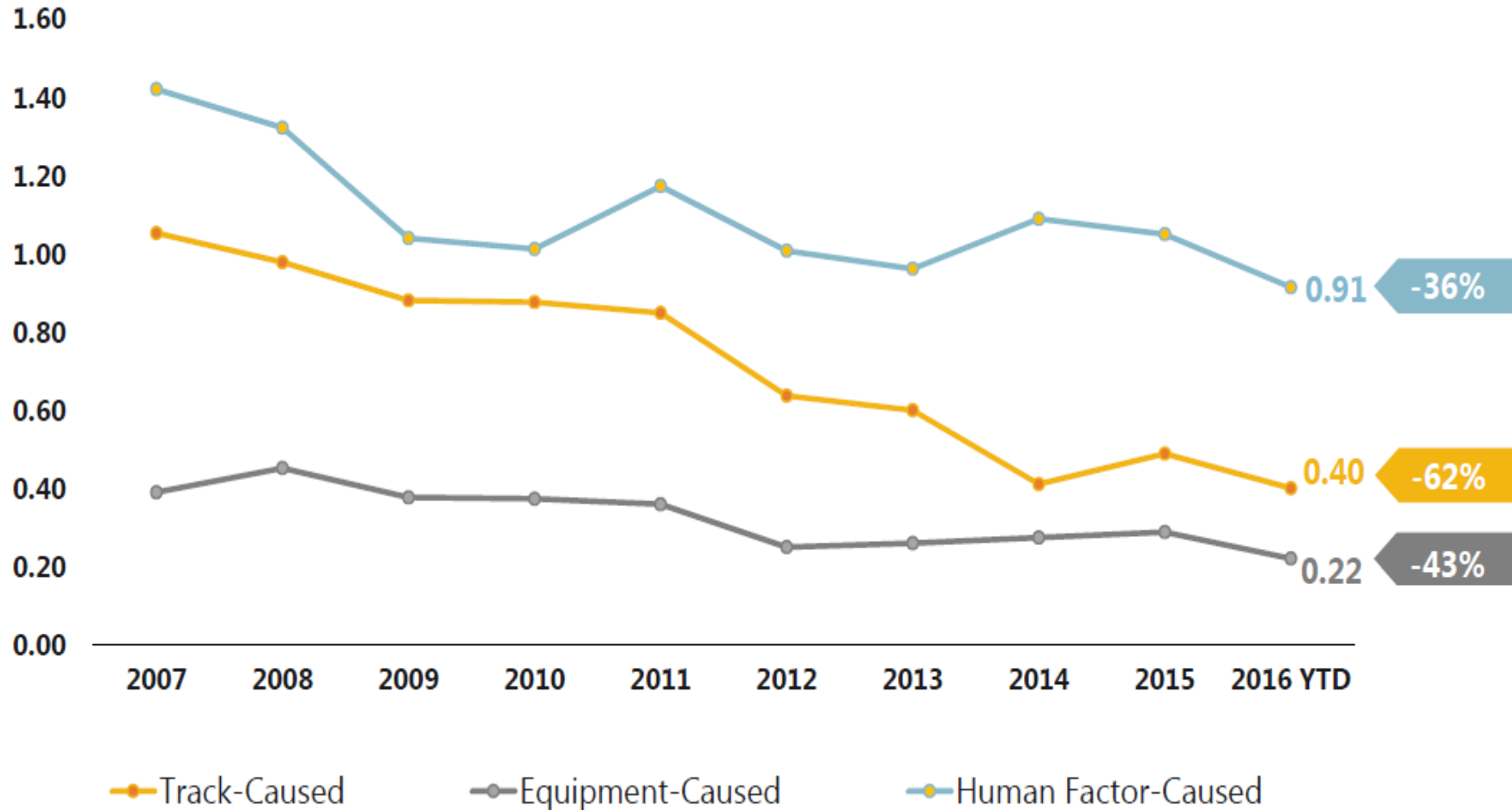
# Positive Train Control

**Predictive, advanced train control safety technology**



# Consistent improvements in safety

Incidents per  
million train-miles

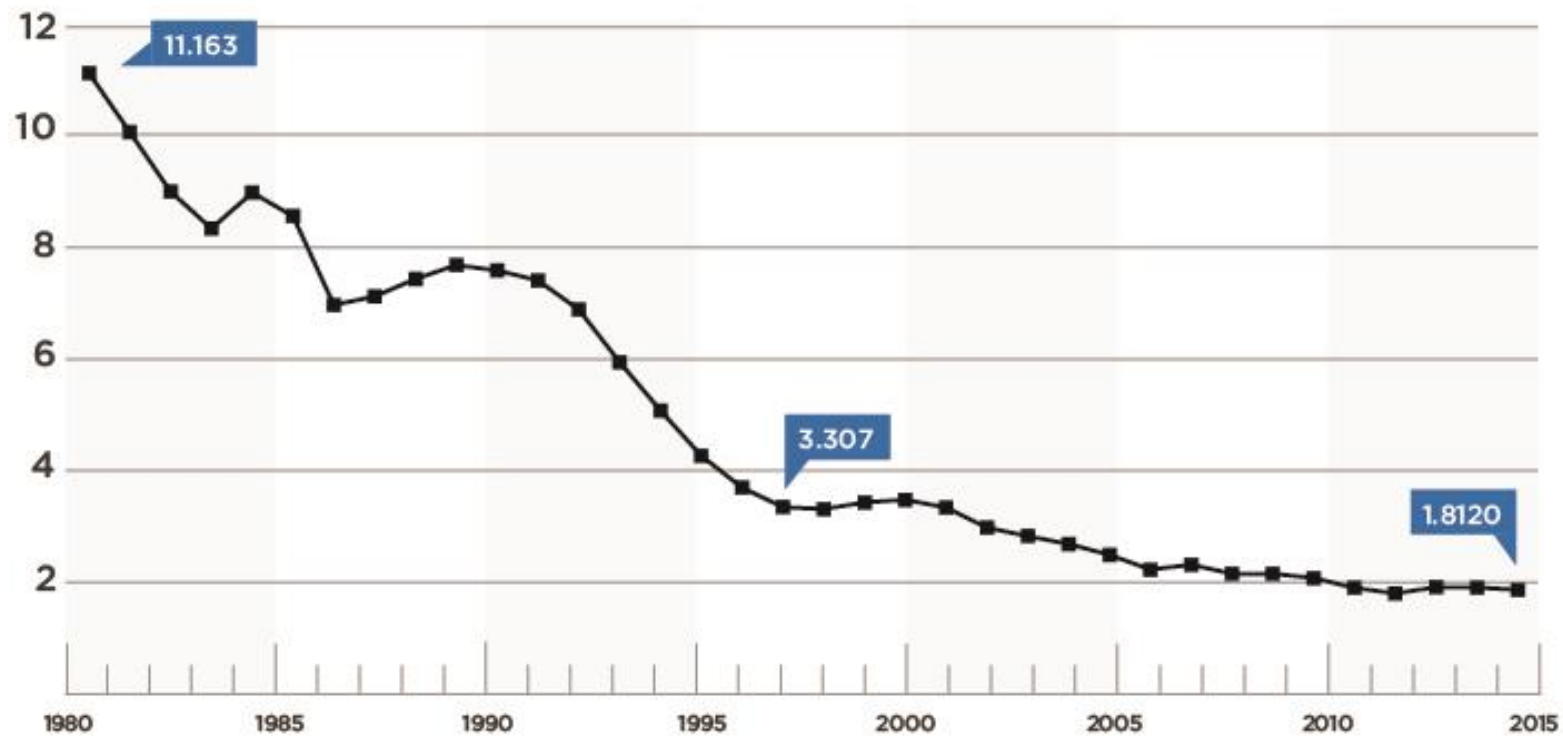




# Decades of safety improvement

## RAILROAD INITIATIVES IMPROVE EMPLOYEE SAFETY

Rail employee casualty rates down 84 percent since 1980 and 47 percent since 2000



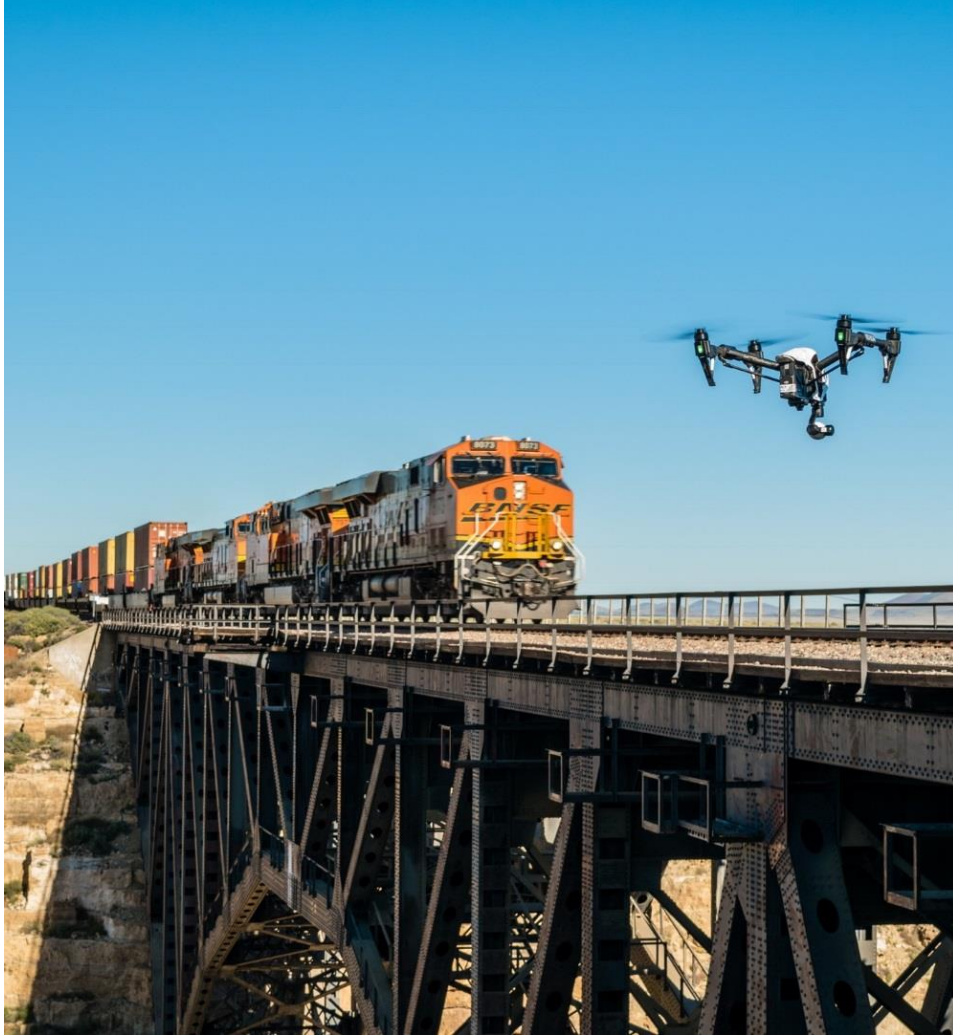
Source: Association of American Railroads

# Unmanned aerial flights





# Unmanned aerial vehicles



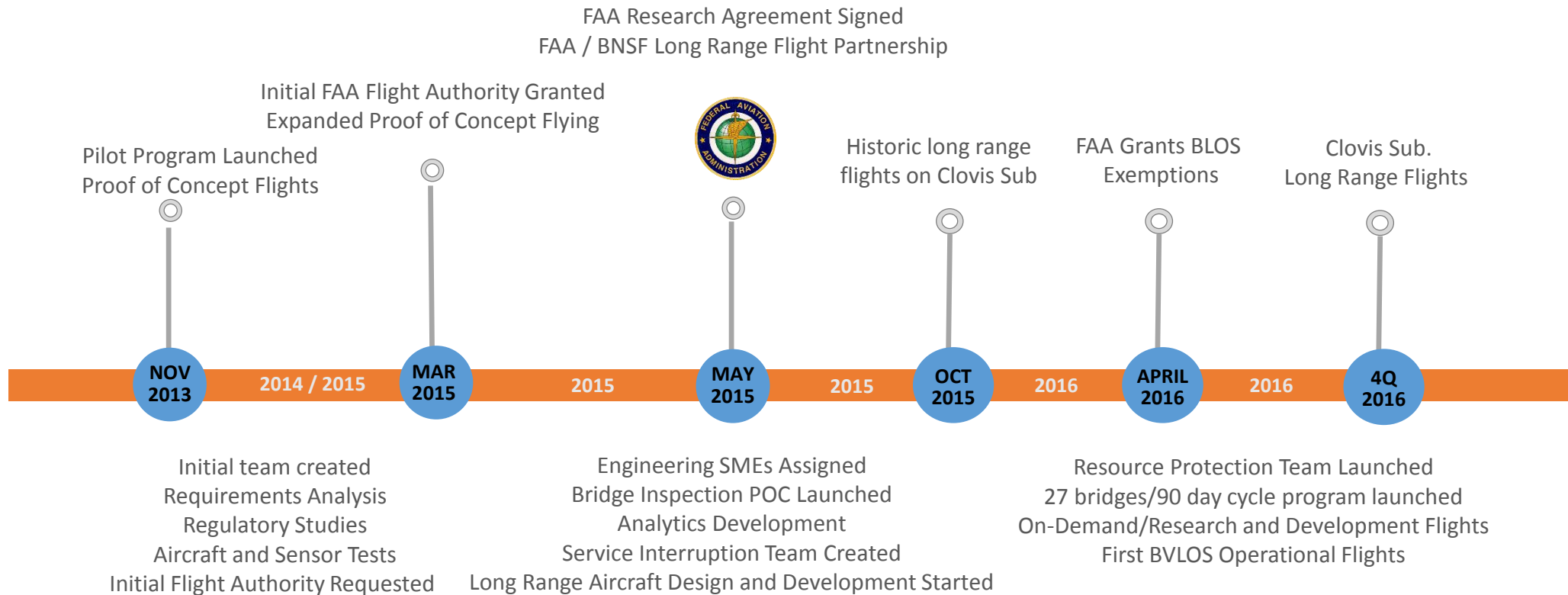
- Various FAA flight authorities (333, 107, SAC)
- Line of sight and non-line of sight
- Leading the industry in adoption and flight capabilities
- Applications: bridge inspections, track integrity, yard inspections, remote areas

# Purpose





# Project timeline



# Line of sight aircraft





# Long range aircraft



# Applications





# Inspecting structures

**Challenges:** bridge inspections, accessibility

**Solutions:** remote inspections, increased safety, improved access, wide range of outputs



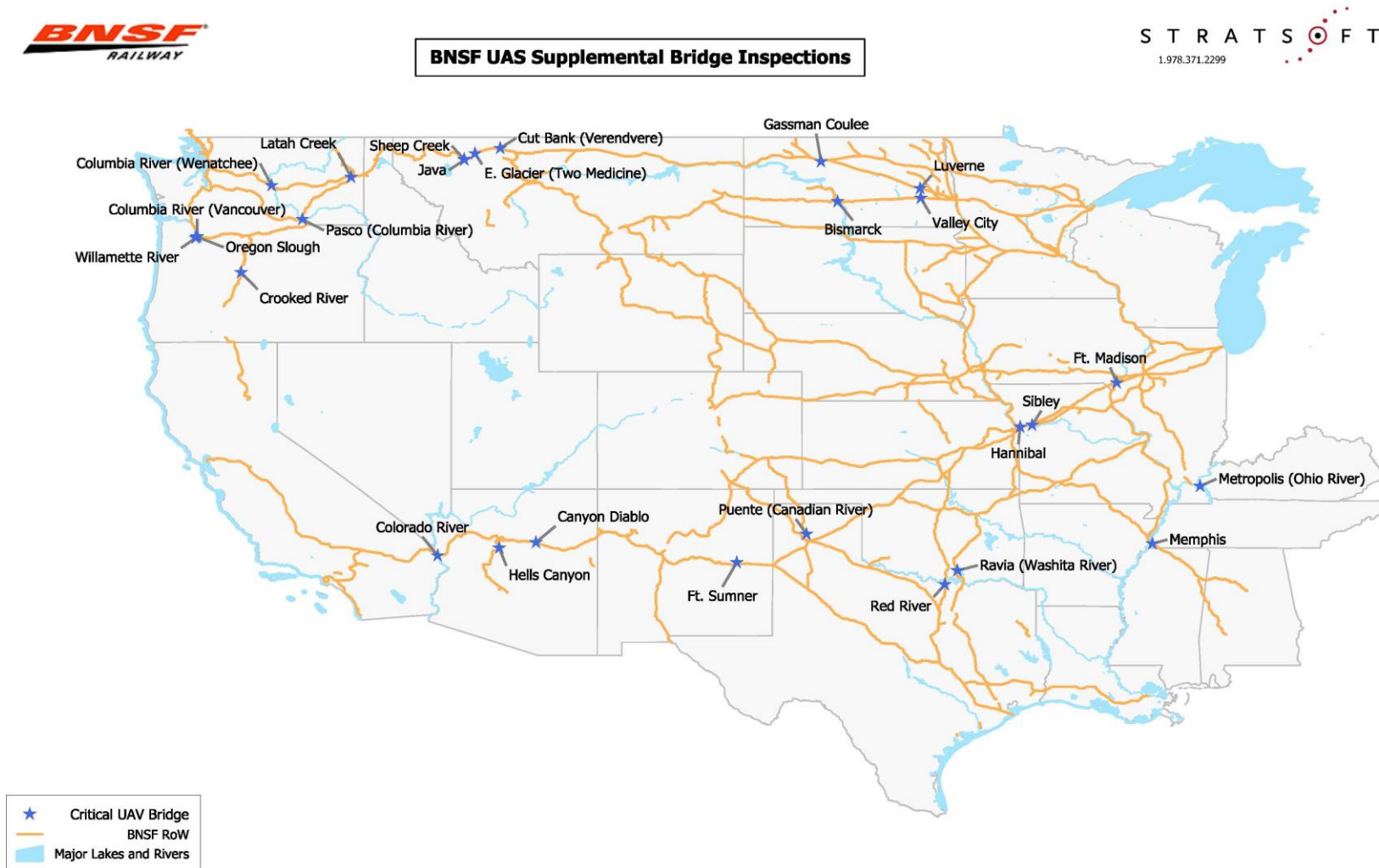
# Inspecting structures

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# Supplemental structure inspections



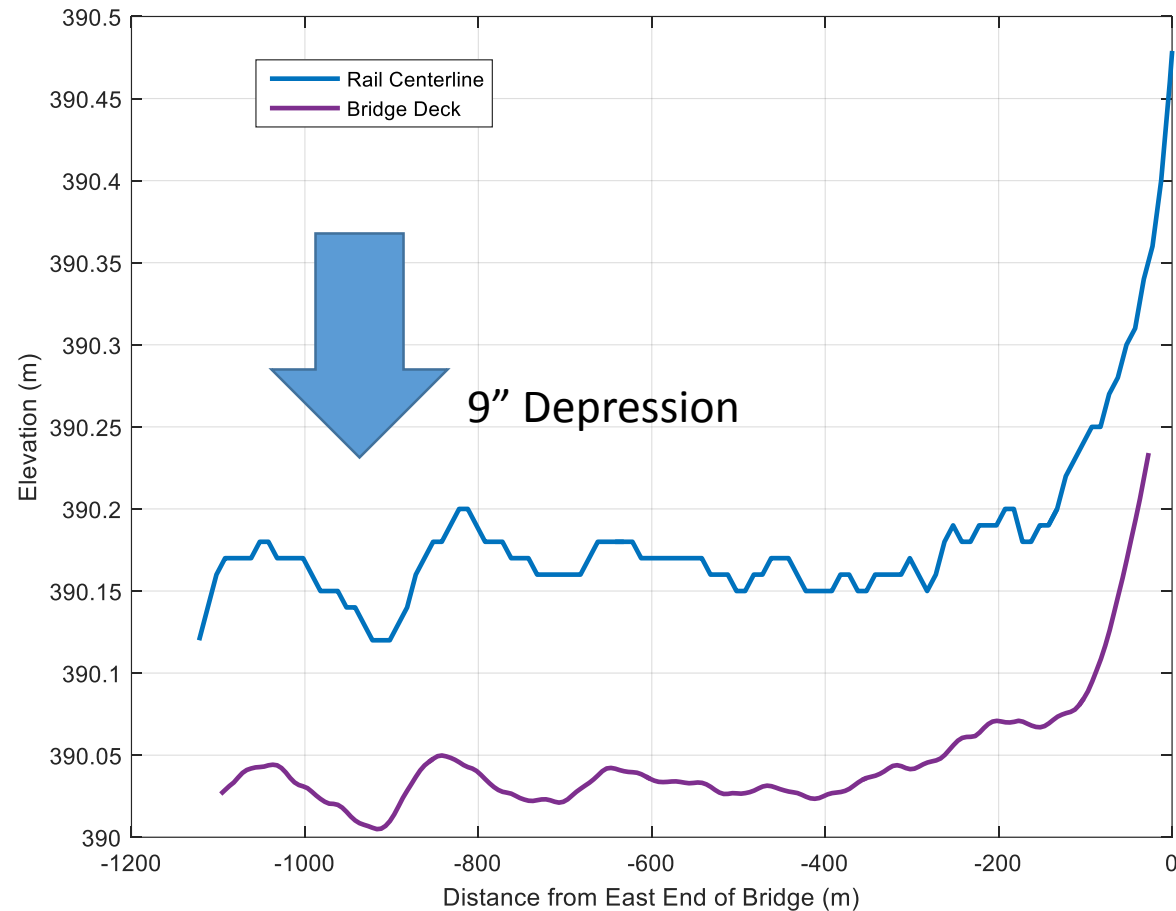


# Lidar bridge deck elevation profile

A simple way to evaluate the profile of the bridge deck through color notation



# Lidar bridge deck elevation profile



# Bridge alignment profile





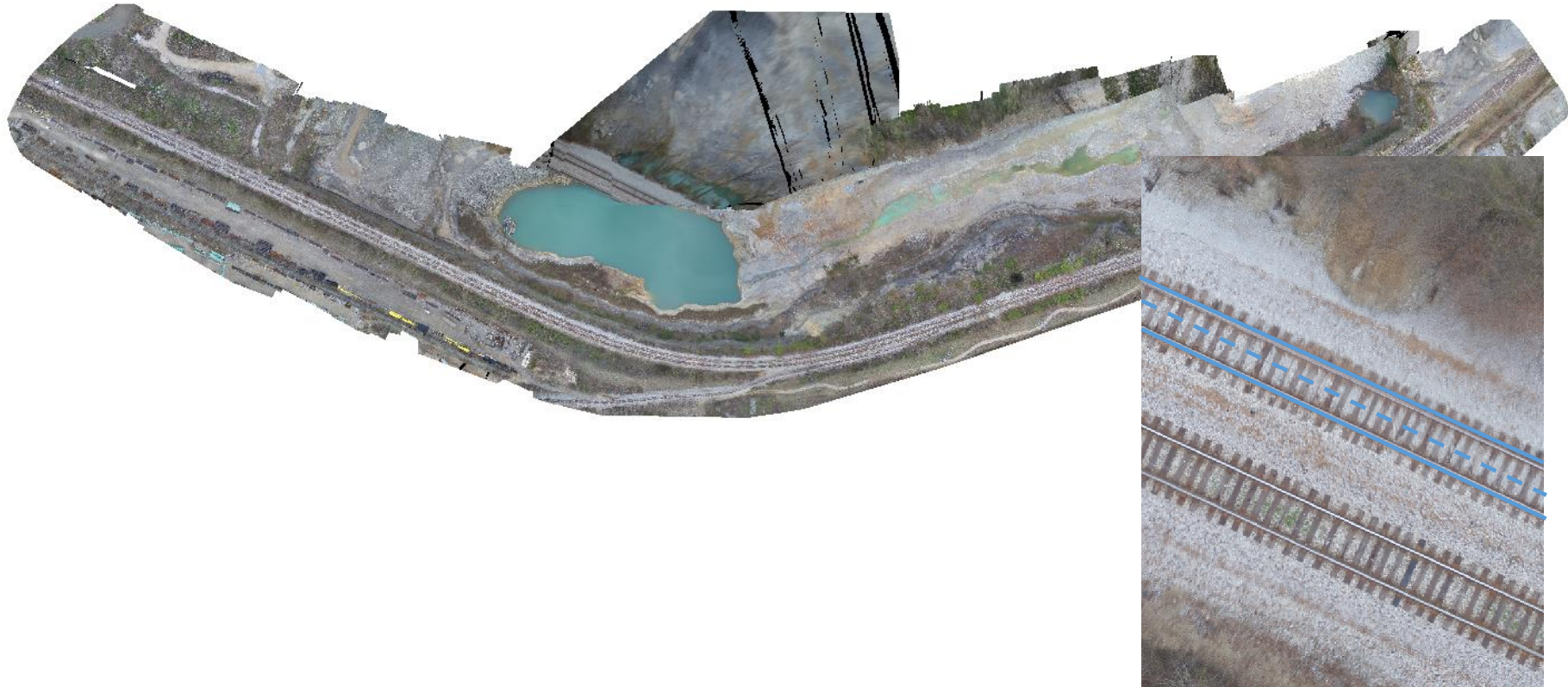
# Right of way change detections

Stitching of UAS imagery to provide a complete view



# Alignment profile change detection

Method creates graphs of track section for monitoring

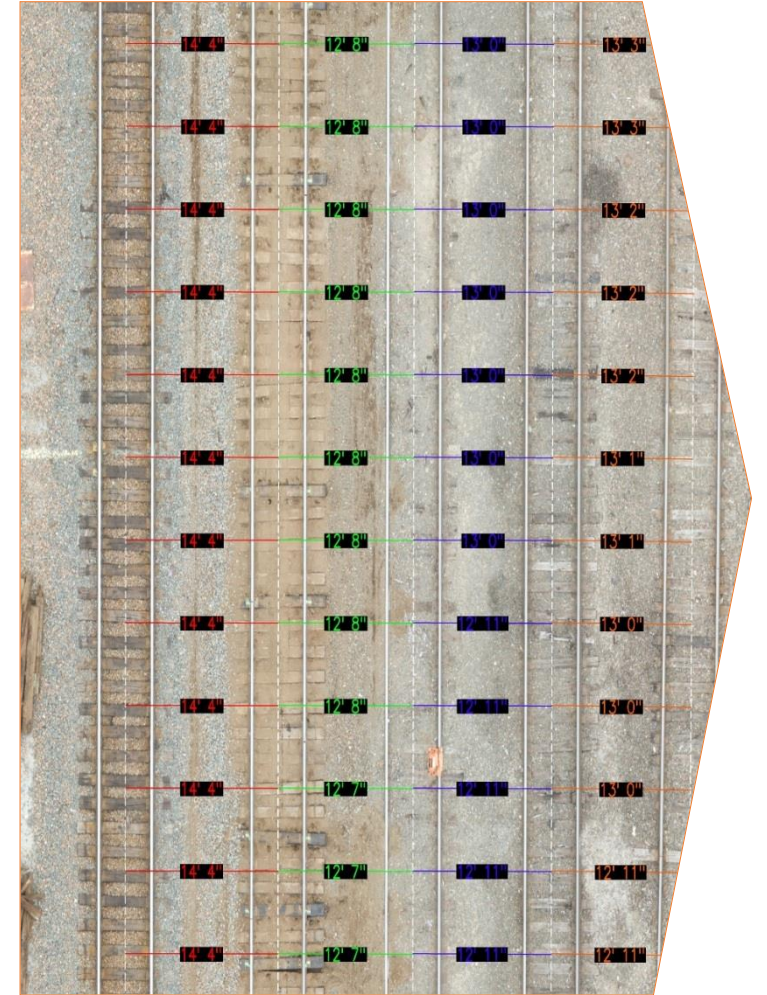




# Close clearance inspections

**Challenges:** identify track movement over time

**Solutions:** modeling tool highlighting centerline, products highlight additional factors

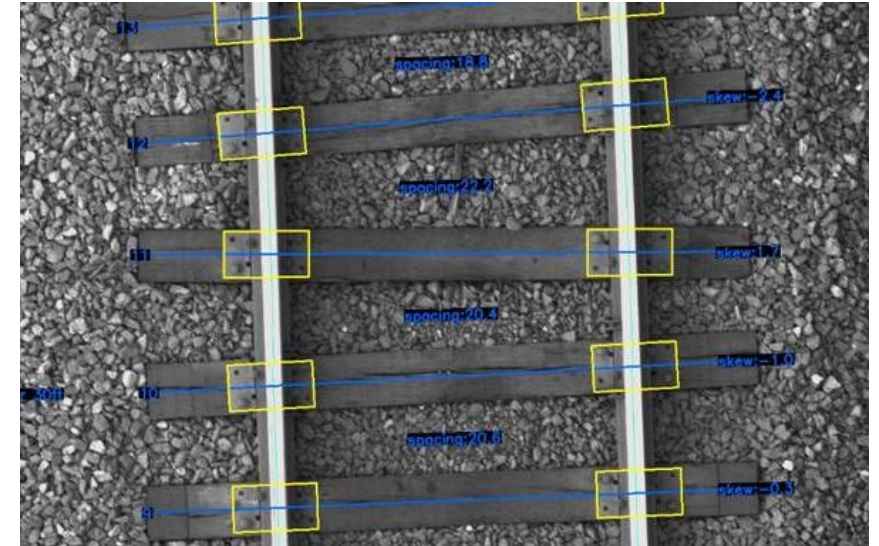




# Supplemental track integrity

**Challenges:** current process requires extensive track occupation

**Solutions:** analytics developed for FRA visual criteria, additional products – heat patrols, load defect detection, tie counts



# Locomotive inspections

**Challenges:** stored locomotives require regular inspections to ensure exhaust covers are in place

**Solutions:** simplified inspection methodology – 1,100 locomotives inspected in less than 7 hours



# Resource protection

**Challenges:** trespass, theft, property recovery, tampering with equipment

**Solutions:** increased safety, efficiency





The image features a BNSF locomotive pulling a freight train, with the entire scene tinted in a monochromatic orange. The locomotive is positioned on the left, facing forward, and the train extends towards the right. The BNSF logo is centered over the locomotive. The logo consists of the letters "BNSF" in a bold, italicized, sans-serif font, with a registered trademark symbol (®) to the upper right. A thick white horizontal line runs beneath "BNSF", starting from the left and ending under the "F". Below this line, the word "RAILWAY" is written in a smaller, italicized, sans-serif font.

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