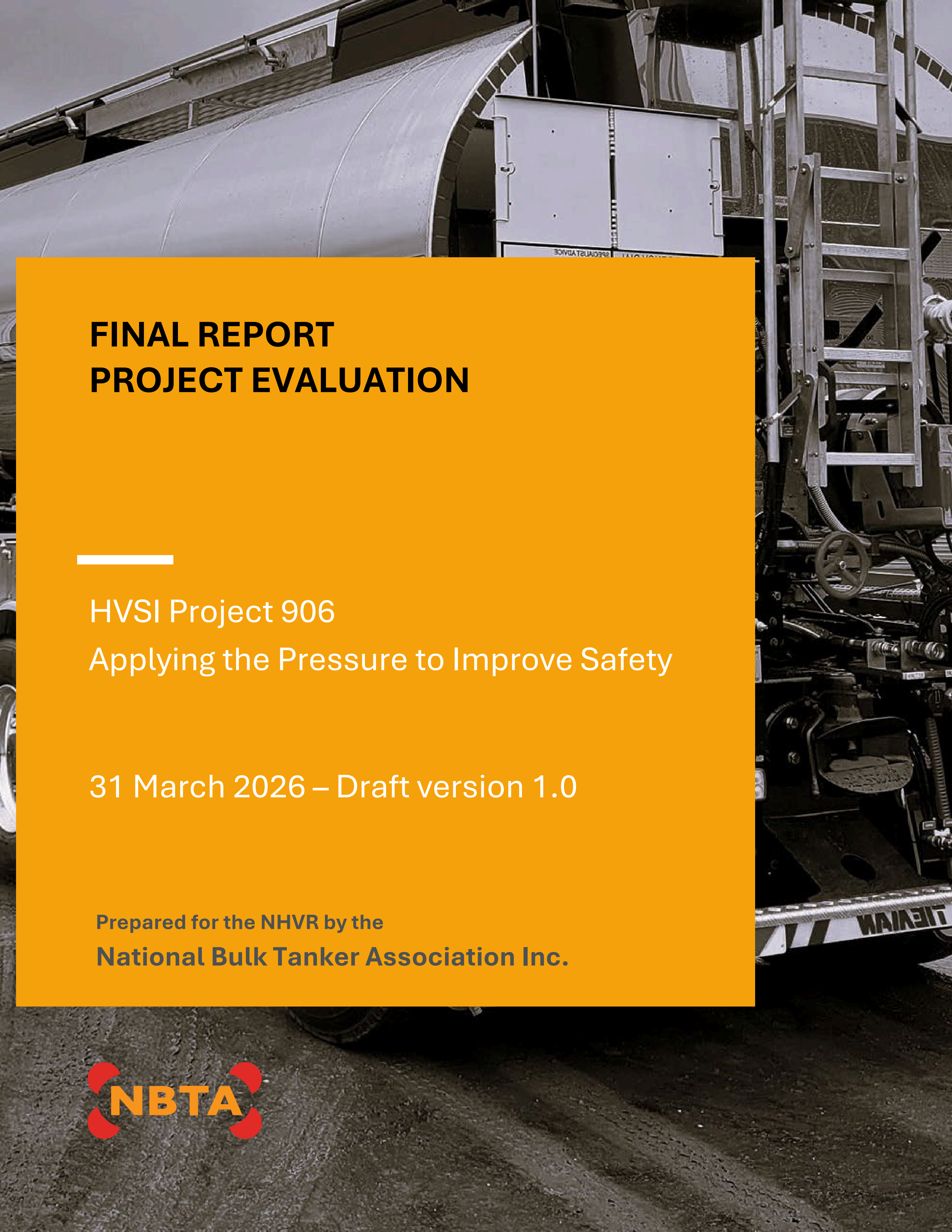

# FINAL REPORT
# PROJECT EVALUATION

## HVSI Project 906
## Applying the Pressure to Improve Safety

31 March 2026 – Draft version 1.0

Prepared for the NHVR by the
**National Bulk Tanker Association Inc.**

NBTA

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# Acknowledgements

## *Partners and collaborators:*

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# 1. EXECUTIVE SUMMARY

This project, *Applying the Pressure to Improve Safety - Preventing Tyre Failures and Fires* (HVSI Project 906), was delivered by the National Bulk Tanker Association (NBTA) under the National Heavy Vehicle Regulator's (NHVR) Heavy Vehicle Safety Initiative.

The project examined how tyre pressure and temperature data from existing Tyre Pressure Monitoring Systems (TPMS), integrated with Electronic Braking Systems (EBS), can be used to improve safety outcomes across the heavy vehicle fleet. The focus was on understanding real-world tyre behaviour, identifying meaningful safety signals within telematics data, and demonstrating practical approaches to presenting this information for industry use.

More than 4.2 million wheel-level TPMS sensor records were collected and analysed from 222 trailers over approximately 745 days. The dataset was transformed into a consistent analytical format, enabling detailed assessment of tyre pressure, temperature, and alert behaviour across a range of operating conditions.

The analysis confirmed that most tyres operate within expected pressure and temperature ranges. However, under-inflation was observed within the dataset, representing a persistent operational and safety risk. Differences between inner and outer tyres were also identified, with inner tyres more likely to exhibit low-pressure conditions, while outer tyres operated at higher temperatures and recorded higher sensor error rates.

A key finding of the project is the imbalance between the volume of TPMS data generated and the proportion that represents actionable safety information. Fewer than 0.2% of TPMS notification messages corresponded to true pressure alarm events, with the majority representing routine system activity rather than safety-critical conditions.

This highlights a fundamental challenge in the use of telematics data for safety: meaningful events can be difficult to identify without appropriate filtering, prioritisation, and interpretation.

The project also found that alert behaviour is strongly influenced by system configuration, with default threshold settings often not aligned to safety-critical conditions.

To address these challenges, the project developed and demonstrated an approach to processing and visualising TPMS data through the RollScope platform. Enhancements to the web-based map and dashboard showed how large datasets can be translated into clear, actionable information for fleet managers and operators.

The findings confirm that existing TPMS and EBS technologies provide a strong foundation for improving tyre safety. Realising this potential requires appropriate system configuration, improved data filtering, and effective visualisation.

Overall, the project demonstrates that telematics data can support a shift from reactive to proactive safety management by improving visibility of tyre condition and enabling earlier identification of emerging risks.

# 2. INTRODUCTION

## 2.1 Project Background

Tyre and wheel-end failures remain a significant safety risk in the heavy vehicle industry, contributing to vehicle fires, loss-of-control incidents, and unplanned maintenance events.

Maintaining appropriate tyre pressure and monitoring temperature are critical to safe operation. Under-inflation can lead to excessive heat generation and increased risk of failure, while elevated temperatures may indicate developing issues that can escalate to tyre damage or fire.

Many trailers are already equipped with Tyre Pressure Monitoring Systems (TPMS) integrated with Electronic Braking Systems (EBS), generating continuous streams of wheel-end data. While this provides a strong foundation for real-time monitoring, the practical use of this data for safety purposes remains limited. Large data volumes, combined with varying system configurations and alert thresholds, can make it difficult to identify meaningful safety signals.

This project builds on previous HVSI work by examining how existing TPMS and EBS data can be effectively accessed, analysed, and presented to support improved safety outcomes.

## 2.2 Purpose of this Report

This report presents the outcomes of HVSI Project 906 and summarises the analysis of TPMS wheel-end sensor data. The report aims to:

- Summarise the data collection and analytical approach
- Present key findings on tyre pressure, temperature, and alert behaviour
- Identify practical implications for improving safety outcomes
- Demonstrate how telematics data can be translated into accessible, actionable information

The report is intended to support fleet operators, industry stakeholders, and regulators in making more effective use of TPMS data for proactive safety management.

# 3. PROJECT OBJECTIVES

Project 906 demonstrates how tyre pressure and temperature data from existing TPMS and EBS systems can be used to improve safety outcomes across the heavy vehicle fleet.

The specific objectives were to:

- Collect and analyse tyre pressure and temperature data from TPMS-equipped trailers
- Improve understanding of tyre behaviour under normal operating conditions
- Identify trends and alert patterns associated with pressure loss and elevated temperature
- Present insights through a web-based map and dashboard
- Share findings with industry to support improved tyre monitoring practices and reduce the risk of tyre failures and wheel-end fires.

## 3.1 Project milestones and delivery schedule

Table 1 lists the project milestones and completion dates.

**Table 1: Milestones and delivery schedule**

| ITEM | MILESTONE | DATE FOR COMPLETION |
|---|---|---|
| Milestone 1 | Execute Agreement. | June 2025 |
| Milestone 2 | Complete Stage 1 - Planning | July 2025 |
| Milestone 3 | Complete Stage 2 - Industry Engagement | August 2025 |
| Milestone 4 | Complete Stage 3 - Data Collection | October 2025 |
| Milestone 5 | Complete Stage 4 - Dissemination of learnings | December 2025 |
| Milestone 6 | Complete Stage 5 - Final Report and Evaluation | March 2026 |

# 4. PROJECT METHODOLOGY

HVSI Project 906 was delivered through a staged approach, progressing from industry engagement, data collection integration and analysis, through to dashboard development and dissemination of findings.

## 4.1 Industry Engagement and Participation

The project commenced with engagement across participating transport operators, telematics providers, and technology suppliers to establish access to tyre pressure monitoring system (TPMS) data. Operators with existing TPMS-enabled trailers were invited to participate and provide access to their data streams.

Engagement focused on leveraging existing hardware installations and telematics infrastructure, ensuring that no additional equipment or disruption to operations was required. Participating fleets voluntarily contributed data for the purposes of analysis, with all data aggregated and de-identified prior to use.

This approach enabled the project to access real-world operational data across multiple fleets, supporting the development of practical and industry-relevant insights.

## 4.2 Data Access and Integration

Tyre pressure and temperature data were accessed through existing Electronic Braking System (EBS) and TPMS integrations within participating fleets. Data retrieval was enabled via secure API connections to participating telematics platforms.

These integrations allowed continuous access to operational data without requiring manual data extraction.

To support the project, backend systems were configured to receive, store, and process incoming data. This included the development of database structures capable of handling high-volume telematics data and supporting subsequent analysis.

All data used in the project was voluntarily provided by operators and was aggregated and de-identified prior to reporting.

### 4.3 Data Processing and Normalisation

Raw TPMS data is typically structured in nested JSON formats and varies between telematics providers. To enable consistent analysis across fleets, all incoming data was transformed into a standardised wheel-level data model and stored in a database.

This process involved:

- Extracting individual wheel sensor records from EBS/TPMS payloads
- Mapping sensor data to consistent wheel position identifiers
- Converting units and formats into a common structure
- Aligning records across different vehicle and axle configurations

The resulting dataset allowed tyre pressure and temperature to be analysed consistently across all vehicles, regardless of differences in original data format or system configuration.

### 4.4 Data Analysis

The analysis focused on identifying trends, distributions, and patterns across large volumes of sensor data, with particular emphasis on distinguishing normal operating behaviour from potential safety-related conditions.

Key analytical components included:

- Distribution analysis of tyre pressure and temperature across the dataset
- Identification of normal operating ranges and outliers
- Comparison of inner and outer tyres in dual wheel configurations
- Assessment of low-pressure and high-temperature conditions
- Analysis of TPMS alert frequency, types, and trigger conditions

Where relevant, subsets of the data were examined under in-motion conditions (e.g. vehicle speed greater than 20 km/h) to better reflect operational behaviour.

The analysis prioritised identification of patterns across the dataset rather than relying on individual sensor readings in isolation, recognising that tyre behaviour is influenced by multiple environmental and operational factors.

### 4.5 Data Visualisation and Reporting Approach

Given the large volume and high frequency of TPMS data, raw data alone is not practical for operational use without appropriate filtering and visualisation.

Data was presented through:

- Aggregated statistical summaries
- Distribution charts for pressure and temperature
- Comparative analysis (e.g. inner vs outer tyres)
- Dashboard-based visualisations
- Web-based mapping of sensor events and individual alert popup detail

The processed TPMS data was presented through a web-based map and online dashboard, enabling summary statistics, visualisations and key insights to be displayed in a simple and accessible format.

### 4.6 Knowledge Dissemination

Participating operators were provided with secure access to detailed TPMS data for their own fleets, including time and location information. This was delivered via a login-protected interface, which also allowed comparison against aggregated industry averages.

Project findings were shared with participating operators and industry stakeholders through workshops, online meetings, and summary reports.

This end-to-end approach ensured that raw telematics data could be translated into practical, actionable safety insights for industry.

# 5. DATASET OVERVIEW

## 5.1 Data Collection Summary

Wheel-end sensor data was collected from participating trailers over the course of the project to support analysis of tyre pressure and temperature behaviour.

The dataset comprised 4,205,389 extracted wheel-level TPMS sensor records. The data collection period spanned from September 2023 to December 2025 (approximately 745 days of recorded data), providing a substantial longitudinal dataset covering a range of operating conditions.

This represents a large-scale real-world dataset of wheel-end sensor behaviour under operational conditions.

## 5.2 Fleet and Asset Coverage

The dataset was derived from:

- 222 trailers
- The 2 participating fleets that recorded TPMS data

While the broader project engaged a larger number of operators, only a subset of fleets had TPMS-enabled data available through telematics systems during the project period.

The distribution of data across fleets was uneven, with one fleet contributing the majority of wheel-level records. Despite this, the dataset provides valuable insight into real-world TPMS performance across a range of trailer configurations and operating conditions.

## 5.3 Sensor Configuration and Coverage

The number of TPMS sensors per trailer varied across the dataset, reflecting differences in vehicle configuration and sensor installation.

Observed characteristics included:

- A range of 1 to 13 sensors per trailer, with an average of approximately 8 sensors per asset
- A mix of single-tyred and dual-tyred axle configurations
- Predominantly tri-axle dual-wheel trailer configurations, representing the majority of the dataset

While most vehicles had consistent and complete sensor coverage, a small number of assets exhibited partial or irregular sensor configurations. These cases are likely due to:

- Partial TPMS installation
- Sensor faults or failures
- Commissioning or retrofitting states

Overall, the dataset demonstrates generally consistent sensor configuration across assets, although gaps in sensor availability were observed across the dataset.

### 5.4 Data Structure and Wheel-Level Mapping

Raw TPMS data was received in nested JSON format, with tyre pressure and temperature data embedded within EBS message payloads.

To support consistent analysis, all data was transformed into a wheel-level dataset, where each record represents an individual wheel-end sensor reading.

Each wheel-level record includes:

- Tyre pressure and temperature
- Timestamp and location
- Vehicle and asset identifiers
- Wheel position codes indicating axle, side, and tyre position

Wheel position identifiers were used to distinguish between inner and outer tyres in dual wheel assemblies, supporting detailed comparative analysis. This wheel-level structure was required for enabling detailed analysis of tyre behaviour across different axle configurations and vehicle types.

### 5.5 Data Limitations and Considerations

While the dataset provides a strong basis for analysis, several limitations should be considered when interpreting the results:

- **Limited fleet representation**: TPMS data was available from only two fleets, and may not be fully representative of the broader heavy vehicle industry.
- **Uneven data distribution**: A significant proportion of the dataset was contributed by a single fleet, which may influence aggregated results.
- **Sensor availability and data gaps**: A significant proportion of records indicated missing or unavailable sensor data (e.g. “not available” states), likely due to incomplete sensor installation, communication issues, or sensor faults.
- **Operational variability**: Tyre pressure and temperature are influenced by factors such as load, speed, ambient temperature, and road conditions, which are not fully controlled within the dataset.
- **High volume of non-alarm messages**: The dataset contains a large proportion of routine TPMS status messages relative to true alarm events, subject to telematics configuration, which influences interpretation of alert frequency.

These factors have been considered in the analysis, with a focus on identifying broad trends and patterns rather than drawing conclusions from individual data points.

# 6. ACTIVITIES

This section highlights the key activities undertaken to deliver the project objective and final outcomes.

## 6.1 Data Collection and Integration

TPMS data was collected from participating fleets through existing telematics integrations. Data collection was established via secure API connections, enabling continuous access to tyre pressure, temperature, and associated event data.

## 6.2 Data Preparation and Validation

Collected data was processed and structured to support analysis. This included validation of incoming data, removal of invalid records, and transformation into a consistent wheel-level dataset.

## 6.3 Data Analysis

Analysis was undertaken to identify trends in tyre pressure, temperature, and alert behaviour across the dataset. This work focused on understanding normal operating conditions, identifying deviations, and assessing the effectiveness of TPMS alerts.

## 6.4 Platform and Dashboard Development

The RollScope platform was enhanced to incorporate TPMS data as shown in Figure 1, including updates to the web-based map and dashboard. These tools were designed to present large volumes of sensor data in a clear and accessible format for industry users.

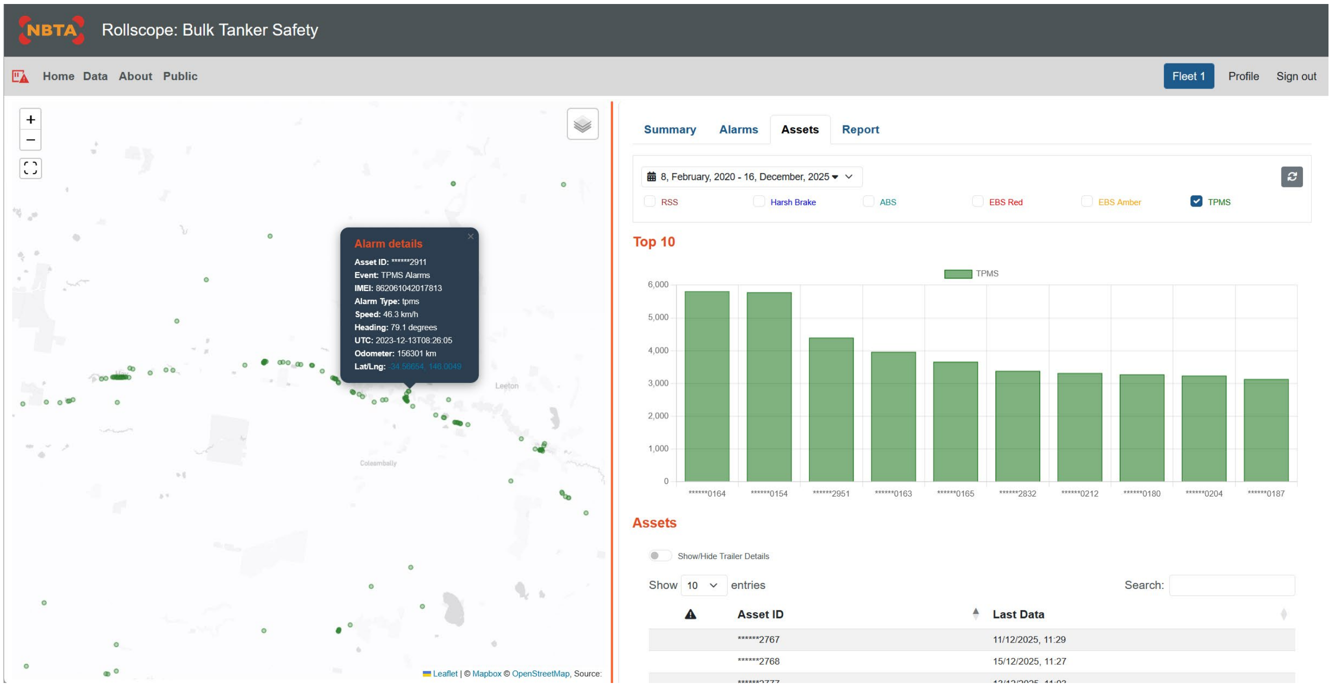



**Figure 1 - Screenshot of the interactive web TPMS dashboard**

## 6.5 Preparation and Communication of Findings

Project findings were compiled and shared with participating operators and industry stakeholders. This included development of summary outputs, updates to the public findings page, and delivery of presentations and workshops.

# 7. KEY FINDINGS

## 7.1 Overview

Analysis of more than 4.2 million wheel-level TPMS records identified several key insights relating to tyre pressure, temperature, and alert behaviour.

The results show that while TPMS systems generate large volumes of operational data, only a very small proportion of this data corresponds to safety-critical events, with the majority representing normal operational behaviour.

## 7.2 Tyre Pressure Distribution

Analysis of tyre pressure readings showed that most tyres operated within expected pressure ranges under normal operating conditions.

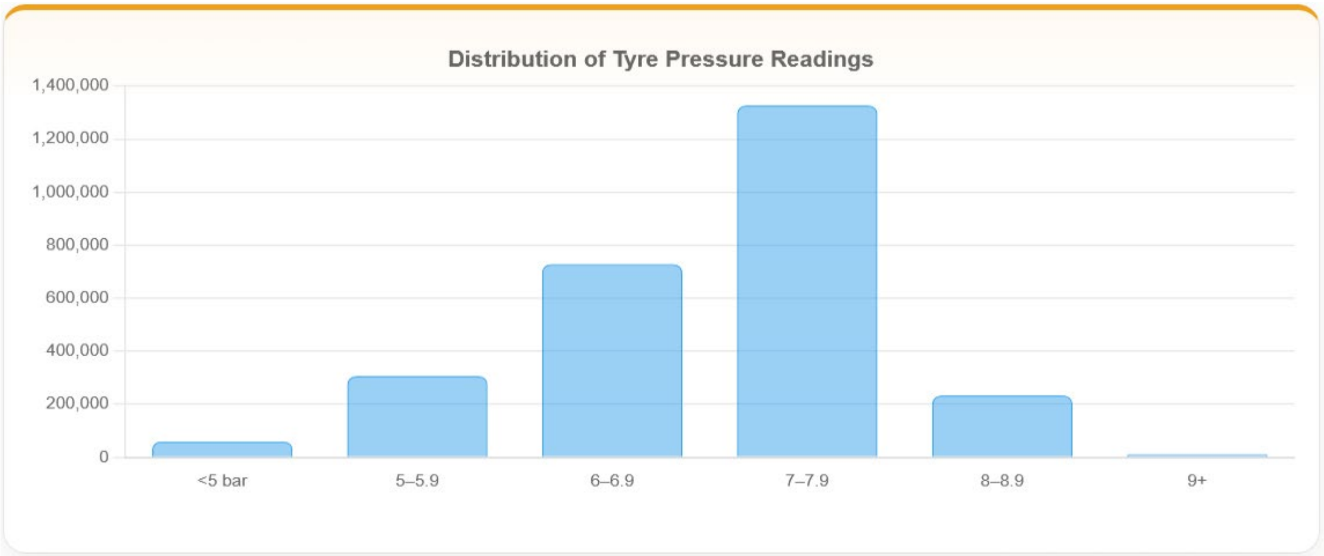



**Figure 2 - Distribution of tyre pressures recorded**

As shown in Figure 2, the strongest concentration of readings was observed between approximately 87-116 PSI (6-8 bar), representing stable and typical tyre inflation levels across the dataset.

However, the dataset also identified:

- A measurable proportion of readings in the 72-87 PSI (5-6 bar) range, indicating moderate under-inflation
- A smaller subset of readings below 72 PSI (5 bar), representing potential risk conditions
- A very small number of high-pressure readings, some of which are likely attributable to sensor anomalies

These results indicate that while most tyres operate within acceptable limits, under-inflation remains present within the dataset and represents a potential safety and maintenance risk.

### 7.3 Tyre Temperature Distribution

Tyre temperature readings were found to be highly consistent and aligned with expected operating conditions.

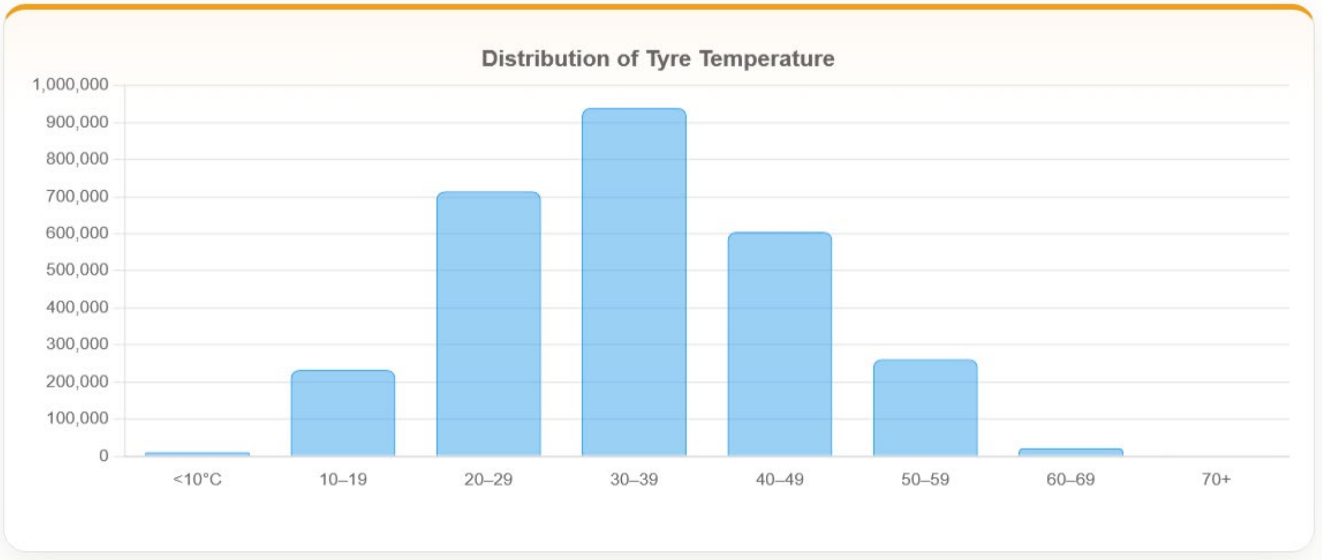



**Figure 3 - Distribution of tyre temperatures recorded**

Figure 3 shows that the majority of readings fell within the range of 20°C to 60°C, reflecting normal thermal behaviour of heavy vehicle tyres during operation.

Key observations include:

- Peak concentration of readings between 30°C and 40°C
- Very limited occurrences of temperatures above 70°C
- No recorded temperatures exceeding 80°C

No temperatures indicative of immediate safety risk were observed in the dataset, suggesting that extreme overheating events are rare, however, this does not diminish the importance of monitoring temperature as part of a comprehensive tyre safety strategy.

### 7.4 Inner vs Outer Tyre Behaviour

Clear and consistent differences were observed between inner and outer tyres in dual wheel configurations.

Key findings include:

- Outer tyres operate at higher average pressures than inner tyres
- Inner tyres exhibit a higher rate of low-pressure conditions
- Outer tyres operate at higher temperatures on average
- Outer tyres record a higher sensor error rate

Table 1 summarises the key pressure and temperature characteristics observed for inner and outer tyres within dual wheel assemblies across the analysed dataset.

**Table 2: Comparison between inner and outer tyres**

| Metric | Inner Tyres | Outer Tyres |
|---|---|---|
| Average pressure | ~96 psi | ~106 psi |
| Low-pressure rate (<70 psi) | 3.1% | 1.9% |
| Average temperature | 30°C | 36°C |
| Maximum temperature | 67°C | 78°C |
| Sensor error rate | 28% | 36% |

These findings align with industry experience, where inner tyres are more difficult to inspect and therefore more prone to undetected under-inflation. Differences in airflow and exposure may also contribute to the higher temperatures observed in outer tyres.

The higher error rate for outer tyres suggests that wheel position influences both physical exposure and sensor reliability.

### 7.5 TPMS Alert Frequency and Characteristics

Analysis of TPMS alert data showed that true alarm events are extremely rare relative to the total volume of TPMS notification messages as shown in Figure 4.

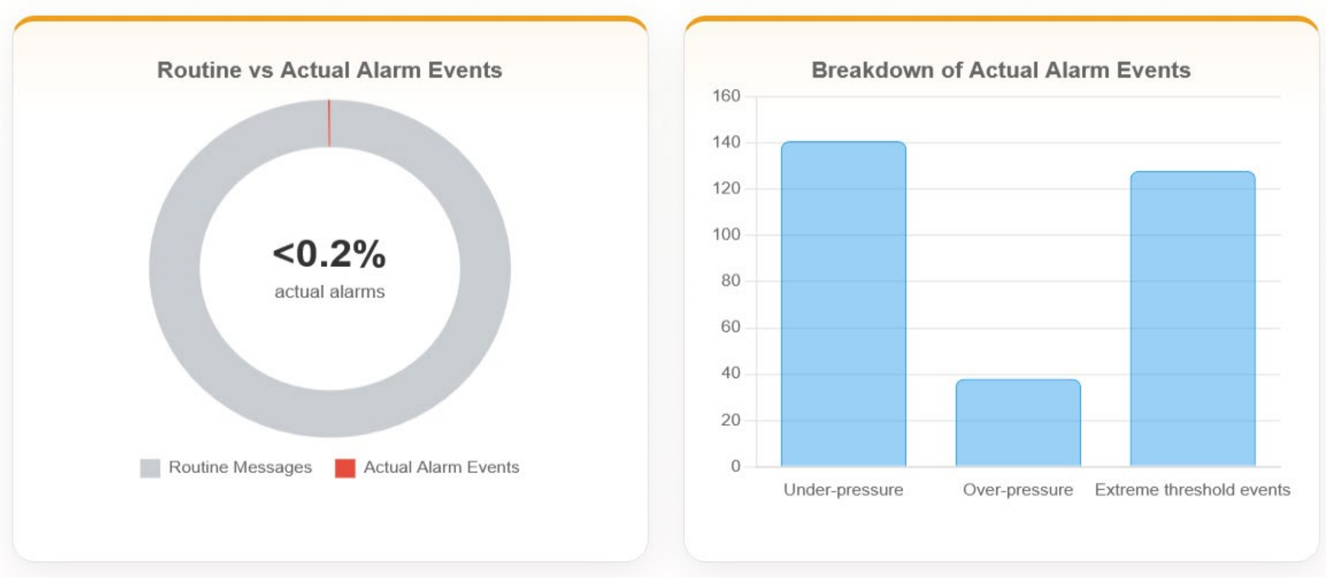



**Figure 4 - Comparison of routine vs alarm events and alert types**

Key observations include:

- Approximately 109,000 TPMS notification messages were recorded
- Approximately 300 (< 0.2%) were classified as true pressure alarms.

The majority of TPMS messages represent routine system status updates rather than safety-critical alerts. This highlights a significant imbalance between routine data and actionable safety events.

Among true alarm events:

- Extreme under-pressure events were the most common
- Over-pressure events were rare.
- Extreme events (both under and over pressure) represent a very small but critical subset

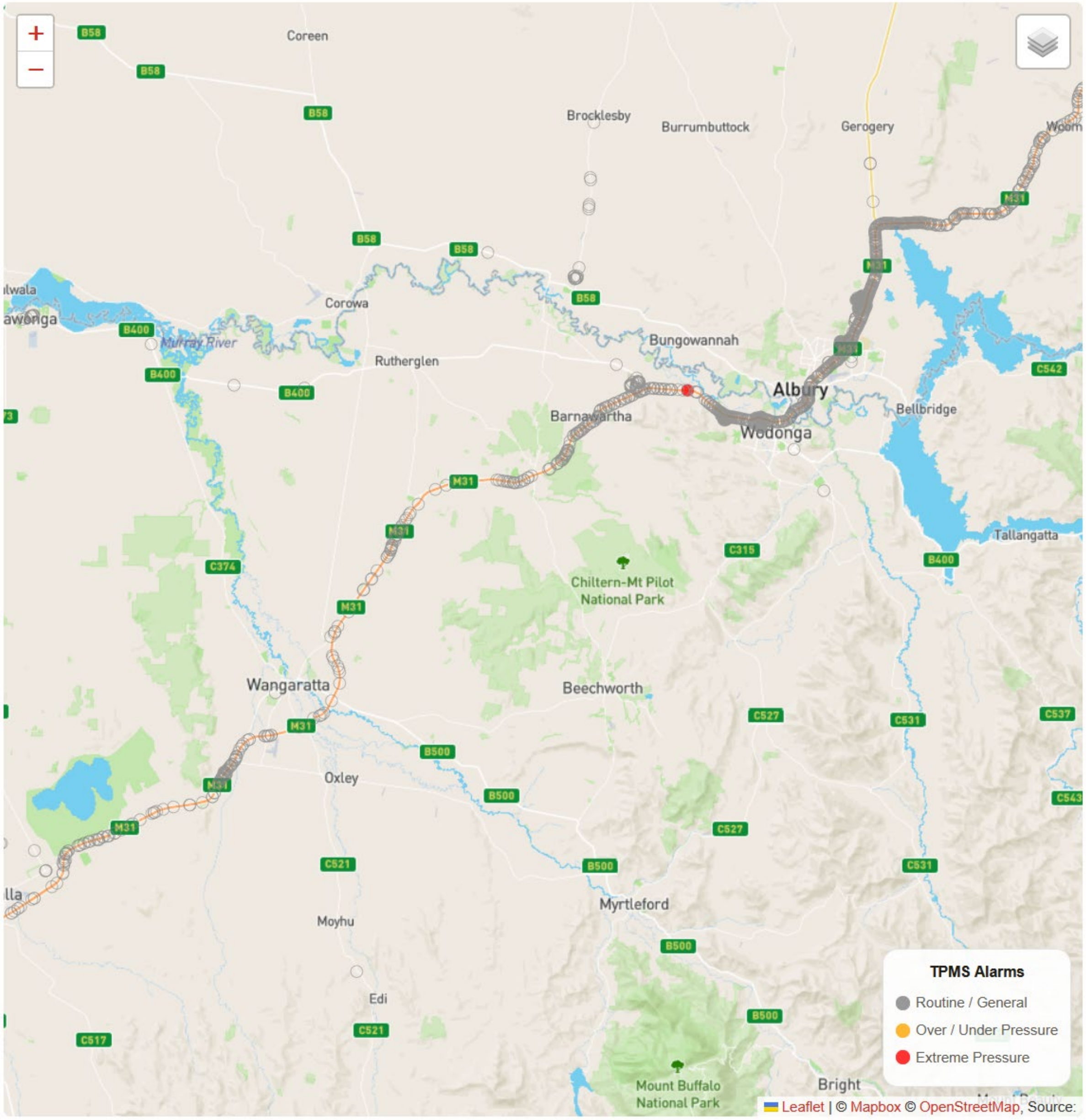



**Figure 5 - Example of interactive TPMS map**

The interactive TPMS map (example section shown in Figure 5) highlights the imbalance between routine TPMS message events and the relatively small number of safety-critical alerts.

These results demonstrate that TPMS systems generate a high volume of non-critical data, which can obscure identification of genuine safety risks without appropriate filtering.

### 7.6 Sensor Availability and Data Gaps

A significant proportion of the dataset included records where sensor data was unavailable or incomplete.

Key observations include:

- A high frequency of “not available” sensor states
- Evidence of partial sensor installation or intermittent data transmission
- Variability in sensor coverage across different vehicles and axle configurations.

These gaps may be attributed to:

- Missing or failed sensors
- Communication issues between sensors and EBS systems
- Differences in TPMS installation across fleets.

While these issues do not invalidate the dataset, they reinforce the need for reliable sensor installation, monitoring, and maintenance practices.

# 8. DISCUSSION

## 8.1 Interpretation of Tyre Pressure and Temperature Data

The analysis demonstrates that tyre pressure and temperature data collected from TPMS systems generally reflects stable and expected operating conditions across the fleet.

Most tyres were observed to operate within normal pressure and temperature ranges, indicating that the majority of the fleet was functioning under acceptable conditions during the period of analysis. However, the presence of under-inflation within the dataset highlights that deviations from optimal conditions do occur and can be identified through continuous monitoring.

Tyre temperature data was found to be generally consistent and within expected operating ranges across the dataset. While no temperature readings indicative of immediate safety risk were observed, this does not diminish the safety value of real-time temperature monitoring.

Events involving extreme tyre temperatures are inherently rare, but when they do occur they can have severe consequences, including tyre failure or vehicle fire. Continuous monitoring of temperature therefore remains an important component of a comprehensive tyre safety strategy, particularly when used in combination with pressure data and operational context.

## 8.2 Factors Influencing Tyre Behaviour

Tyre pressure and temperature are influenced by a range of environmental and operational factors, which must be considered when interpreting TPMS data.

Key influencing factors include:

- Ambient temperature and geographic location
- Vehicle load and payload distribution
- Tyre specification and recommended inflation pressure
- Vehicle speed and braking activity
- Road surface and operating conditions.

These variables contribute to natural fluctuations in pressure and temperature readings during normal operation. As a result, individual sensor readings may vary significantly without necessarily indicating a safety issue.

The findings reinforce that interpretation of TPMS data should be based on trends and patterns over time rather than isolated readings, and that operational context is critical in distinguishing between normal behaviour and potential risk conditions.

### 8.3 Interpretation of TPMS Alerts

The analysis shows that TPMS systems generate a high volume of messages, the majority of which are not associated with safety-critical conditions.

Most TPMS messages represent routine system status updates or threshold transitions rather than genuine alerts requiring immediate action. True alarm events—such as extreme under-pressure or over-pressure conditions—are relatively rare.

This distinction is important, as it highlights that TPMS systems are not inherently configured to prioritise safety-critical alerts. Instead, alert behaviour is heavily influenced by system configuration, particularly threshold settings.

Without appropriate interpretation, the high volume of routine messages may reduce the visibility of genuinely important events.

### 8.4 Signal vs Noise in TPMS Data

A key finding of the project is the imbalance between the volume of TPMS data generated and the proportion of data that represents actionable safety information.

The dataset shows that:

- The vast majority of TPMS messages relate to normal operating conditions
- Only a very small proportion of messages represent true alarm events
- Routine messages can significantly outnumber safety-critical alerts

This creates a “signal vs noise” challenge, where meaningful safety signals can be difficult to identify within large volumes of routine data.

Without filtering, prioritisation, and appropriate visualisation, there is a risk that important alerts may be overlooked or diluted within normal operational data.

Key implications include:

- **Threshold configuration is critical**: Default TPMS settings are often not aligned with safety-critical conditions and may generate excessive non-critical alerts
- **Data filtering is required**: Systems must distinguish between routine messages and events requiring attention
- **Visualisation is essential**: Large datasets must be presented in a way that allows users to quickly identify trends and anomalies
- **Context matters**: Pressure and temperature readings must be interpreted in relation to operating conditions

The project demonstrates that TPMS systems provide a strong foundation for improving safety outcomes, but their effectiveness depends on how data is configured, interpreted, and presented.

# 9. PRACTICAL IMPLICATIONS FOR INDUSTRY

## 9.1 Use of TPMS Data for Safety Monitoring

Building on the findings of this project, effective use of TPMS data requires filtering and visualisation approaches that prioritise actionable information. To be useful in practice, TPMS data must be filtered and interpreted in a structured way that allows meaningful safety signals to be identified. This reinforces the importance of integrating TPMS data into operational processes, rather than treating it as a passive data source.

## 9.2 Alert Threshold Configuration

The analysis indicates that TPMS alert thresholds are often configured using default settings, which may not align with safety-critical conditions.

Default thresholds are typically designed to support tyre management objectives such as tyre life and fuel efficiency, and may generate alerts for relatively small variations in pressure. As a result, systems may produce a high number of alerts that do not represent immediate safety risks, while critical events remain relatively rare. To improve safety outcomes, consideration should be given to:

- Reviewing and adjusting alert thresholds based on operating conditions
- Differentiating between maintenance alerts and safety-critical alerts
- Ensuring that extreme conditions are clearly identified and prioritised

## 9.3 Importance of Data Filtering and Visualisation

A key challenge identified in the project is the imbalance between the volume of TPMS data generated and the proportion of data that represents actionable safety information.

Without appropriate filtering, large volumes of routine data can make it difficult to identify meaningful events. Effective use of TPMS data therefore requires:

- Filtering of routine messages to highlight significant events
- Aggregation of data to identify trends over time
- Visualisation tools that allow rapid interpretation of data

Dashboard-based approaches, such as those demonstrated through the RollScope platform, provide a practical solution by translating complex datasets into clear and accessible information.

### 9.4 Maintenance and Sensor Reliability

The presence of missing or unavailable sensor data within the dataset highlights the importance of maintaining reliable TPMS installations.

Sensor availability directly affects the ability to monitor tyre condition and identify potential risks.

To support effective use of TPMS systems, operators should consider:

- Regular inspection and maintenance of sensors
- Monitoring of sensor availability and data quality
- Ensuring that all critical wheel positions are appropriately instrumented

Improving sensor reliability will enhance the overall effectiveness of TPMS as a safety tool.

### 9.5 Integration into Fleet Safety Practices

The project demonstrates that TPMS data can support improved safety outcomes when integrated into broader fleet safety practices.

Potential applications include:

- Real-time safety alerts
- Use in talks and driver briefings
- Identification of recurring issues across specific vehicles or routes
- Monitoring of fleet-wide trends in tyre condition
- Supporting maintenance and inspection programs

By embedding TPMS data into routine operational processes, operators can move from reactive responses to a more proactive approach to tyre safety management.

## 10. PROJECT OUTCOMES

The project successfully demonstrated how tyre pressure and temperature data from existing TPMS installations can be accessed, processed, and used to generate meaningful safety insights for the heavy vehicle industry.

Key outcomes of the project include:

- **Establishment of a large-scale TPMS dataset**
  More than 4.2 million records were collected and analysed, providing an evidence base for understanding tyre behaviour under real-world conditions.
- **Improved understanding of tyre pressure and temperature behaviour**
  The analysis provided insight into typical operating ranges, the occurrence of under-inflation, and the variability of temperature across operating conditions.
- **Identification of limitations in TPMS alert behaviour**
  The project demonstrated that TPMS systems generate a high volume of routine messages relative to true safety-critical alerts, highlighting the importance of appropriate threshold configuration and data interpretation.
- **Demonstration of a practical data processing and analysis approach**
  The project established a repeatable method for transforming telematics data into a dataset suitable for analysis across fleets and vehicle configurations.
- **Enhancement of the RollScope platform**
  The project delivered updates to the RollScope web map and dashboard, enabling TPMS data to be visualised and interpreted in a practical and accessible format.
- **Translation of data into actionable insights**
  The findings were communicated through dashboards, interactive reports, and stakeholder engagement, supporting improved understanding of how TPMS data can be used in practice.

Overall, the project has demonstrated that existing TPMS and EBS technologies provide a strong foundation for improving tyre safety. When supported by appropriate data processing, interpretation, and visualisation, these systems can contribute to more proactive and informed safety management across the heavy vehicle fleet.

# 11. PROJECT EVALUATION

## 11.1 Project success

***Did you meet your expected outcomes/objectives?***

- Yes, the project met its primary objectives. Awareness of the safety benefits of monitoring tyre pressure and temperature through TPMS and EBS data has increased across participating operators and industry stakeholders.
- The RollScope online platform was successfully enhanced and deployed, providing a practical and accessible way to visualise and interpret wheel-end sensor data through an interactive web map and dashboard.
- The project demonstrated that meaningful safety insights can be derived from existing in-vehicle systems, establishing a low-cost pathway for industry to monitor tyre condition and identify potential risks.
- Practical outputs, including safety reporting formats and data visualisations, have been developed and shared, supporting operators to better understand fleet performance. Early engagement indicates that operators are using these insights to inform maintenance practices and operational discussions, contributing to improved safety outcomes across the bulk tanker sector.

## 11.2 Lessons learned

***What worked well***

- Strong collaboration between industry partners, including transport operators, and EBS suppliers/telematics providers, enabled reliable data sharing. This was underpinned by the trusted relationships already established between the association, operators and service providers.
- The use of specialised contractors with the required technical expertise was critical to the successful development and deployment of the system. Direct feedback from dashboard users supported iterative improvements and informed future development.

- The project demonstrated the value of leveraging existing in-vehicle systems, showing that meaningful safety insights can be generated without additional hardware investment, supporting a scalable and low-cost pathway for broader industry adoption. It also enabled efficient data collection and the creation of an anonymised evidence base that can be shared with government and regulators to directly inform policy development.

***What didn't work well***

- The project relied on existing in-vehicle systems, with no new technology installed as part of the project. As a result, variations in uptake and use of these systems across fleets, and in some cases the disconnection of services during the project, limited the breadth and continuity of data available. This highlights broader barriers to adoption of these technologies across the industry.
- During the data collection phase, changes to external telematics platforms and service providers rendered existing API connections invalid, requiring reconfiguration at our end. This impacted system integration and resulted in a temporary loss of data during the transition period.
- While feedback from participating operators was strong overall, engaging with smaller operators proved more difficult, likely due to resource constraints and varying levels of technological maturity across the sector.

***What could be improved in the future***

- Focus on increasing uptake of TPMS and EBS data-sharing across fleets by addressing barriers to adoption of existing in-vehicle systems and supporting operators to enable and maintain these services.
- Develop more standardised and adaptable API frameworks to accommodate changes in external telematics platforms and improve the resilience of data integration.

### *Gaps and Areas for Further Work*

- Enhance guidance and support materials, including practical tools and short resources, to help operators interpret TPMS data and apply insights to maintenance and operational practices. This should include improving understanding of EBS functionality, the importance of regular maintenance, and ensuring systems are correctly set up, connected and operating fault-free from the outset.
- Improve industry understanding of TPMS alerts and data interpretation, including expected operating temperature ranges, identification of abnormal conditions, and how alerts should be interpreted and responded to in an operational context.
- Expand engagement with regulators and road authorities to promote the value of aggregated, anonymised data in identifying systemic risks and supporting evidence-based policy and infrastructure decisions.

### *Feedback and Survey Results*

- Feedback from workshops and one-on-one meetings indicated that operators found the web map and dashboard useful or very useful for identifying risks and informing safety conversations. Participants highlighted the value of having a visual tool to engage drivers and to pinpoint high-risk locations on their routes.
- Operators also noted the significant volume of raw telematics data generated across their fleets, which makes it impractical to manually review or extract meaningful insights. The platform helped address this by filtering and visualising key information; however, feedback indicated there is still a need to further simplify and refine the interface to make it more intuitive and to more clearly highlight critical safety risks.
- A majority expressed interest in continued participation and ongoing updates to the platform.

## 12. KEY LEARNINGS

The project identified several key learnings relating to the use of TPMS data, system configuration, and the practical application of telematics data for safety.

**High data volume requires prioritisation of meaningful signals**

TPMS systems generate large volumes of data, most of which reflects normal operating conditions. Effective use of this data requires filtering and prioritisation to ensure that safety-critical events can be clearly identified.

**System configuration influences safety outcomes**

Alert behaviour is strongly influenced by threshold configuration. Default settings are often aligned to tyre management objectives rather than safety, and may not clearly distinguish high-risk conditions without adjustment.

**Sensor reliability underpins system effectiveness**

The presence of missing or unavailable sensor data highlights the importance of reliable installation, monitoring, and maintenance. Consistent sensor coverage is essential to ensure that TPMS systems can effectively identify potential risks.

**Existing systems provide a strong foundation for improvement**

The project confirms that current TPMS and EBS installations provide a scalable foundation for improving tyre safety. With targeted improvements to configuration, data handling, and system design, these technologies can deliver greater practical value to industry.

## 13. FUTURE STEPS

The project has identified several opportunities to further enhance the use of telematics data for safety and operational decision-making. Key areas for further development include:

**Improved data integration and timeliness of information**

- Streamline data integration to support near real-time monitoring of vehicle and system status.

**Enhanced dashboard usability and accessibility**

- Continue improving the dashboard to make it clearer, simpler, and quicker to use, especially for time-constrained users.

**Focus on actionable safety indicators**

- Develop clearer safety indicators to highlight critical issues and system status, so users can quickly identify what needs attention without being overwhelmed by low-value data.

**Expansion of data coverage and participation**

- Increase the number of participating fleets and improve consistency of data collection to better represent the broader fleet.

**Integration of system health and compliance monitoring**

- Build on the combined use of TPMS and EBS data to provide a clearer view of overall vehicle readiness, system functionality, and emerging risks.

**Ongoing industry engagement and knowledge sharing**

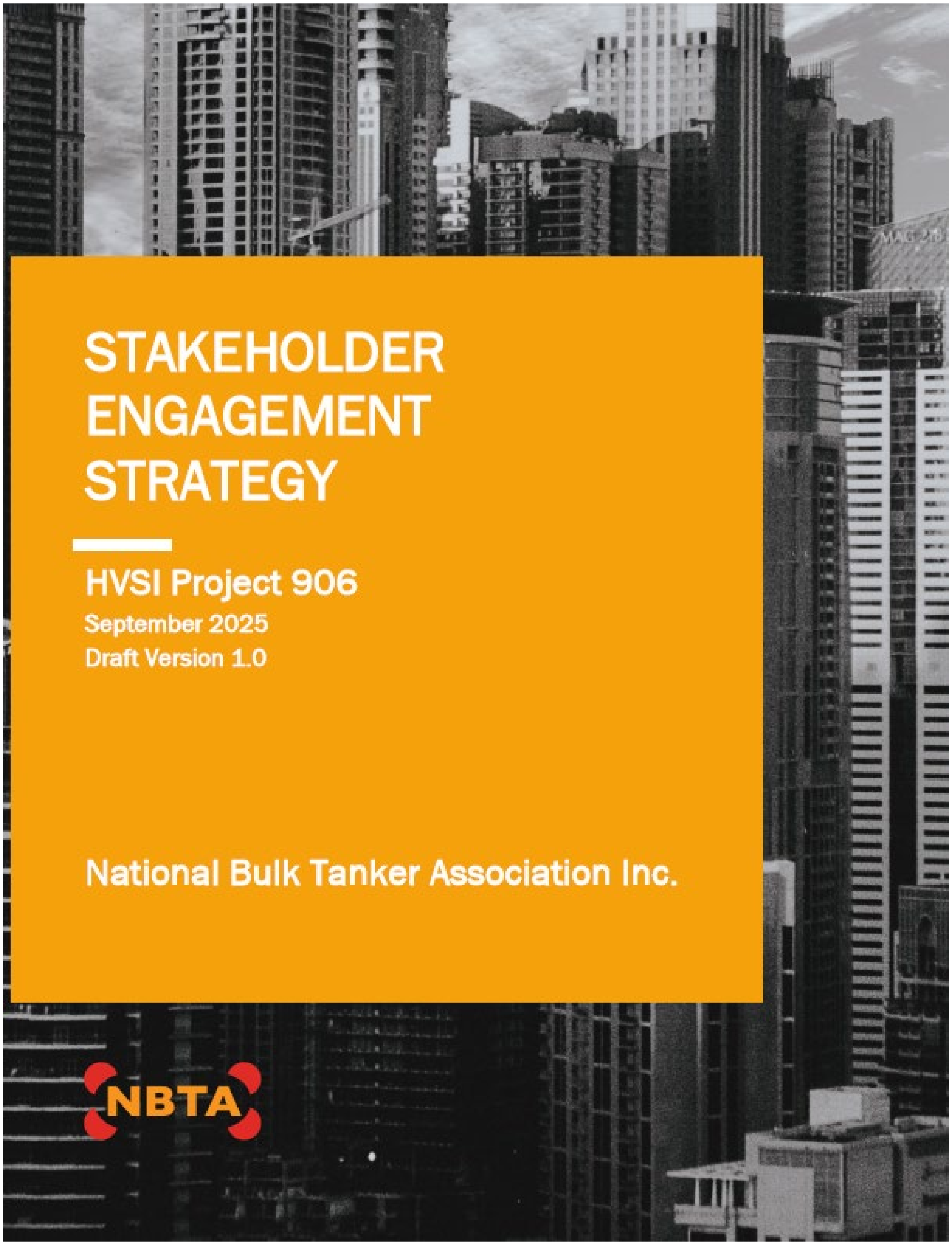
- Continue collaboration with operators and stakeholders to support the use of EBS data to proactively manage safety.

Overall, the project showed that telematics data can support more proactive and informed management of vehicle condition to improve safety. Making data integration and reporting simpler will be key to getting the most value from the data available from these technologies.

# Appendix A

### Appendix A.1 – Stakeholder engagement strategy

Cover page only. See attachment *NBTA-HVSI-906 Stakeholder Engagement Strategy.pdf*



## Appendix A.2 – Data Collection Plan

*Cover page only. See attachment NBTA-HVSI-906 Data Collection Plan.pdf*


DATA COLLECTION PLAN

HVSI Project 906

September 2025

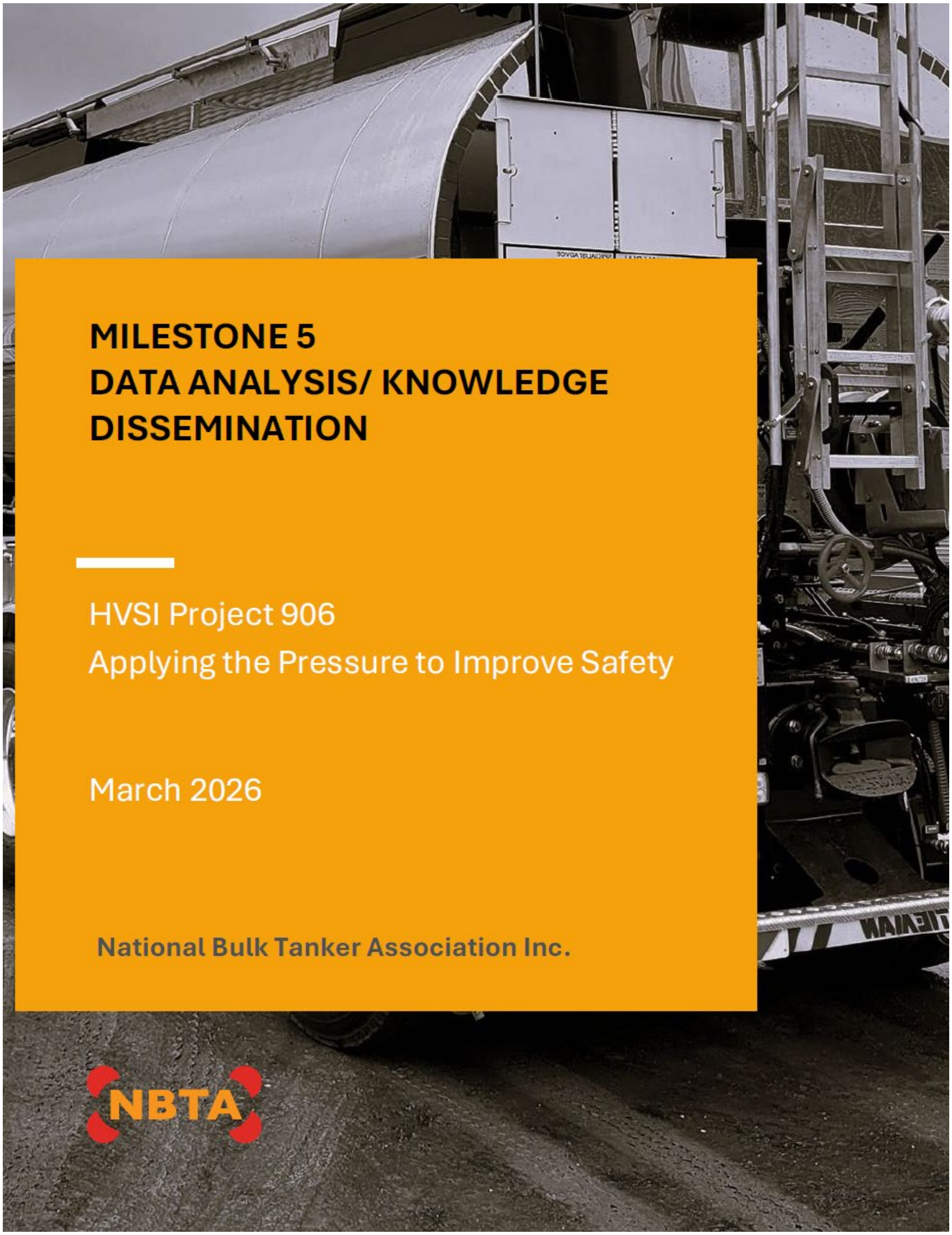
Draft Version 1.0

National Bulk Tanker Association Inc.

NBTA

## Appendix A.3 – Data Analysis and Knowledge Dissemination

*Cover page only. See attachment NBTA-HVSI-906 MS5 Report.pdf*



# Appendix B

**AppendixB.1 – Project summary presentation March 2026**

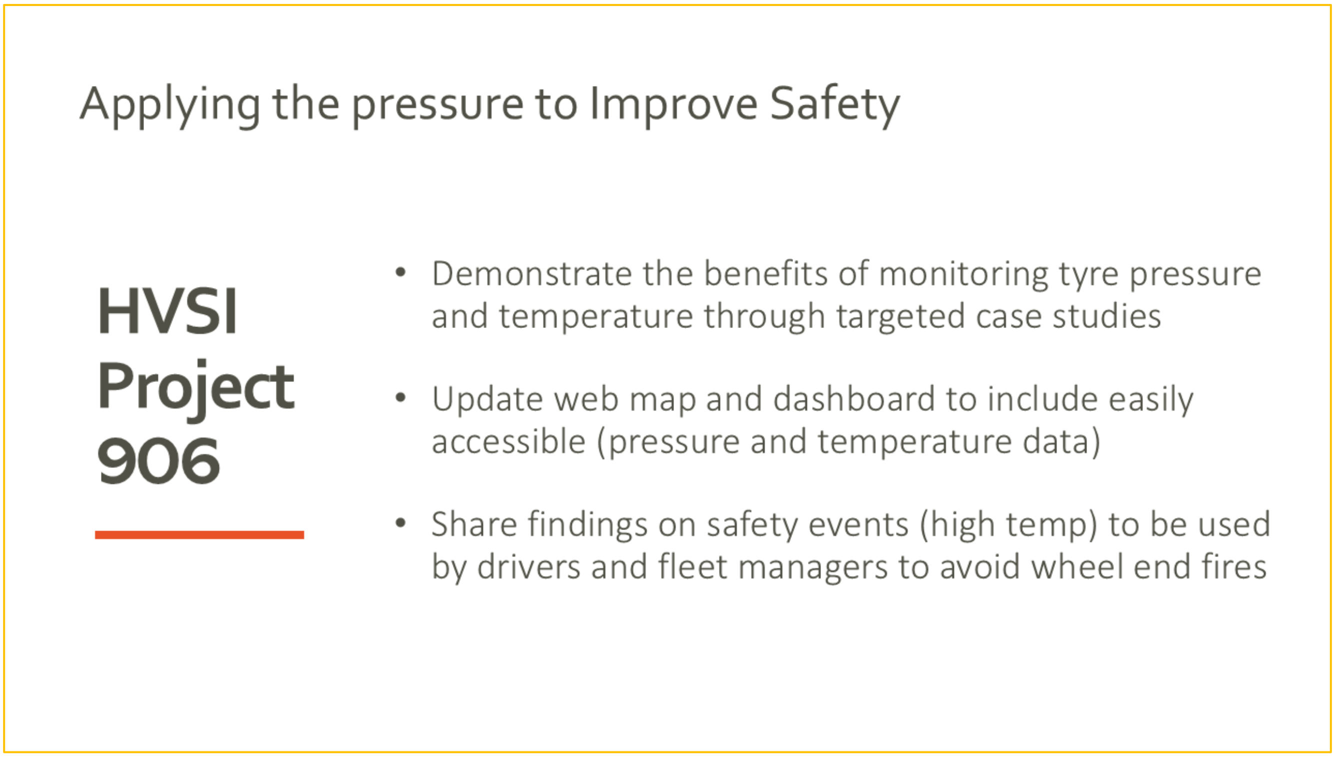



*Image credit: Gold Fields, Gruyere Joint Venture*

## Ammonia Nitrate explosion - WA 2022

## Project Motivation

A preventable safety issue with high consequences.

Tyre failures and wheel-end fires is a major **BUT PREVENTABLE** safety issue for the heavy vehicle industry

- Tyre and wheel-end failures are a leading cause of truck fires and loss-of-control events. (WA DEMIRS, 2023)
- Incorrect tyre pressure is one of the most common mechanical issues identified in heavy vehicle inspections. (NHVR study)
- Maintaining correct tyre pressure can reduce the risk of blowouts and wheel-end fires, improve handling and braking, and extend tyre life. (NBTA analysis, 2025)

Image credit: adapted from DEMIRS, WA

## Started from a wheel end fire

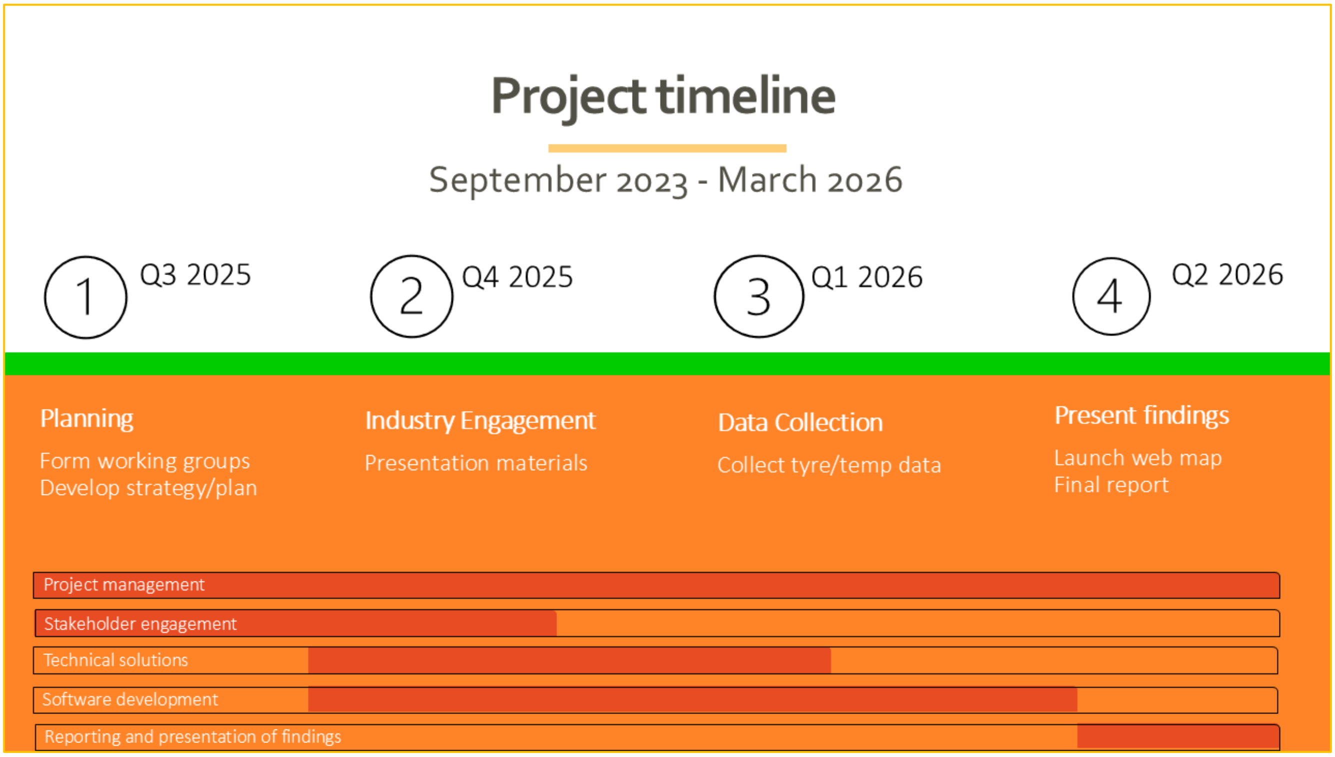
*“These changes were probably inevitable, Centurion is already starting to fit out its fleet to meet the new anticipated standards.”*

Chris Donovan, Centurion

*“A lot of the measures that we have been speaking about are of the reactive type, we would like to see is some proactive solutions.*

Andy Hogg, Orica

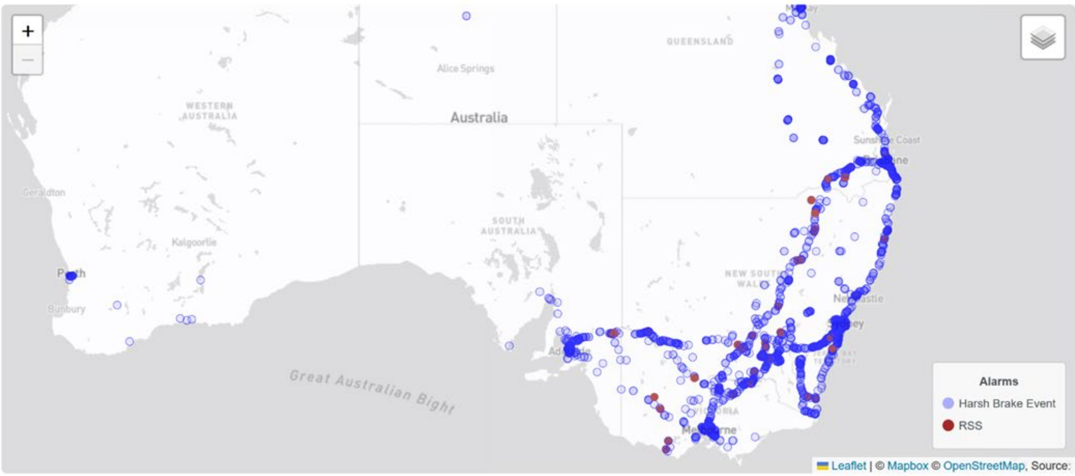
## Industry perspective

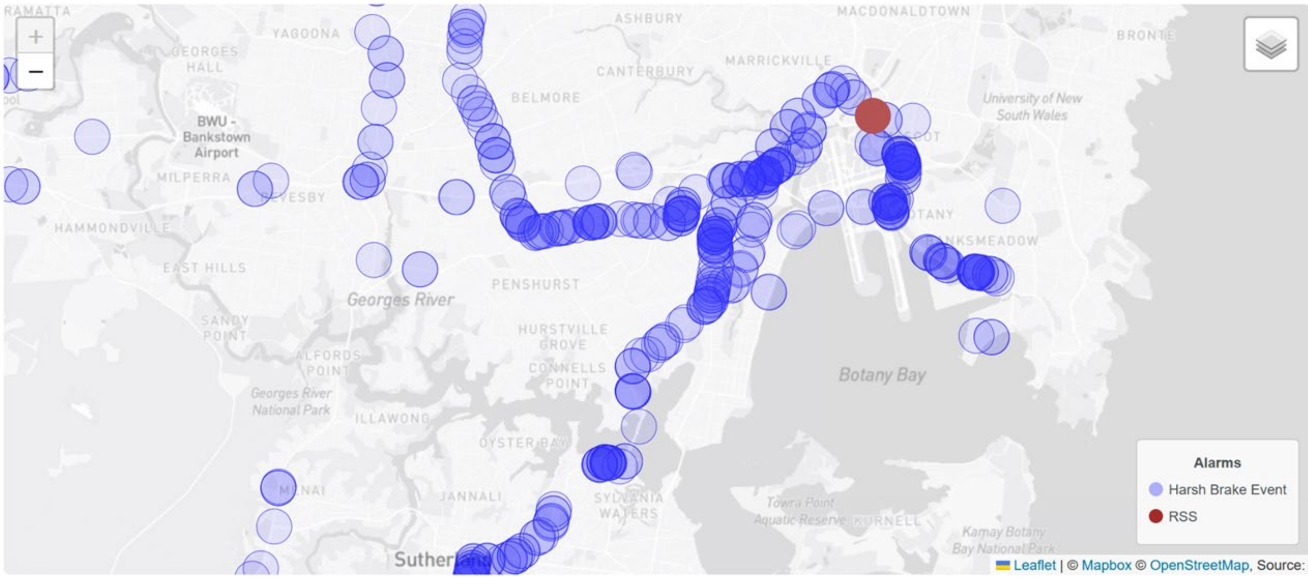



This Heavy Vehicle Safety Initiative is proudly led by the **National Bulk Tanker Association (NBTA)** and its participating members. Supported by the **National Heavy Vehicle Regulator's (NHVR)** Heavy Vehicle Safety Initiative (HVSI) program and funded by the Australian Government, this project reflects a shared commitment to creating safer roads for the heavy vehicle industry and all road users.

The map and dashboard below show the ongoing EBS Roll stability and harsh braking alarms collected to date collected from many operating fleets.

Find out more about the project here.




YAGOONA
ASHBURY
MACDONALDTOWN
BRONTE
GEORGES HALL
CANTERBURY
MARRICKVILLE
BELMORE
University of New South Wales
BWU - Bankstown Airport
MILPERRA
HAMMONDVILLE
EAST HILLS
Georges River
PENSHURST
SANDY POINT
HURSTVILLE GROVE
CONNELLS POINT
Georges River National Park
ILLAWONG
OYSTER BAY
Botany Bay
JANNALI
SYLVANIA WATERS
Towra Point Aquatic Reserve
KURNELL
Kamay Botany Bay National Park
Alarms
Harsh Brake Event
RSS
Leaflet | © Mapbox © OpenStreetMap, Source: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Telematics: Safer Trailers
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Public
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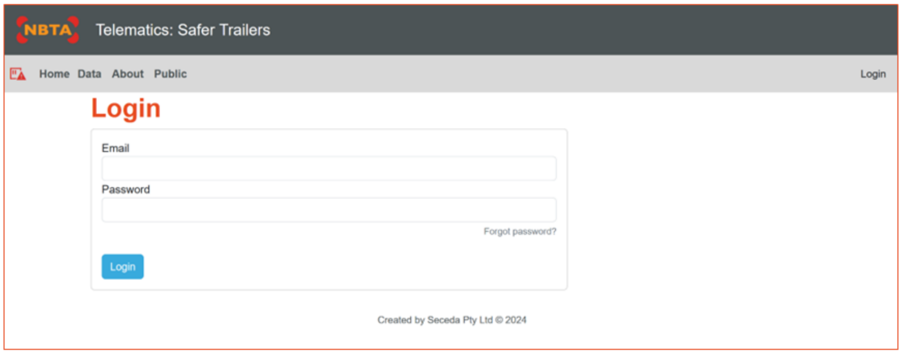
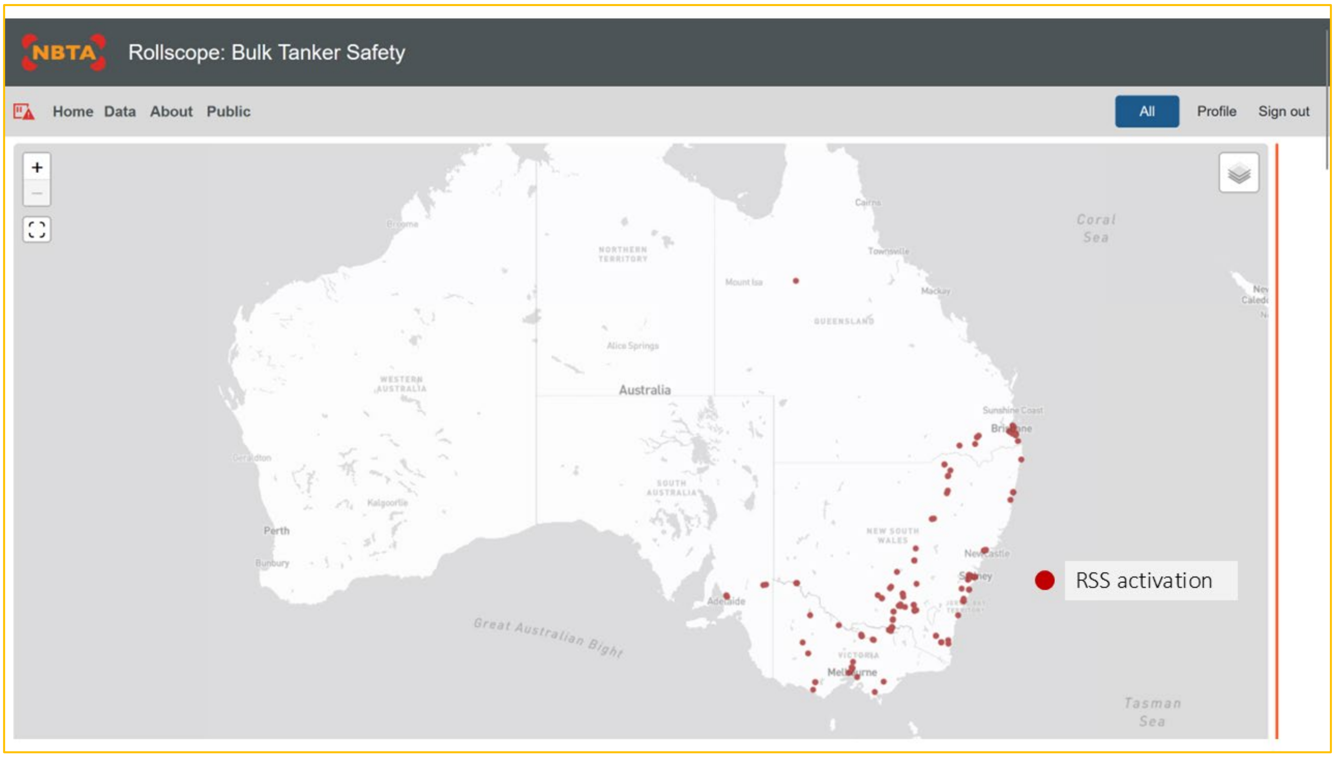
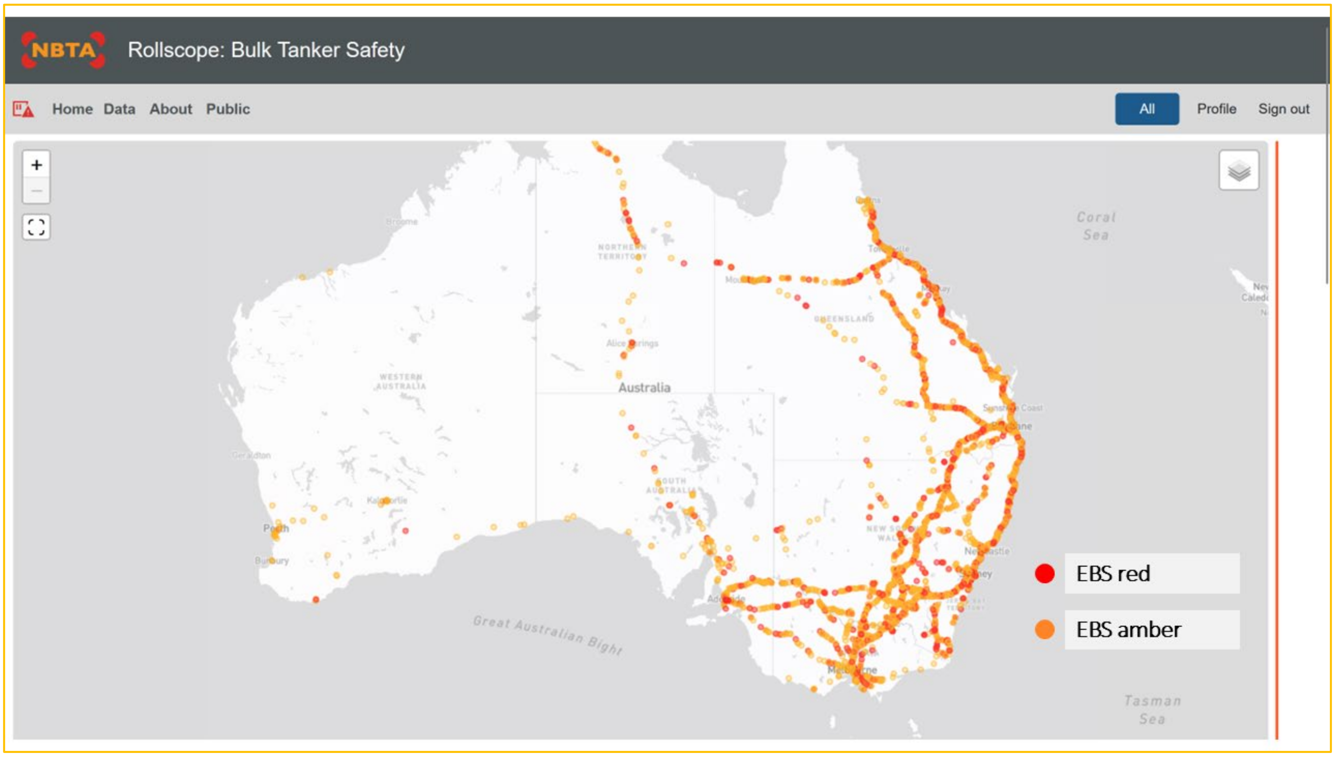
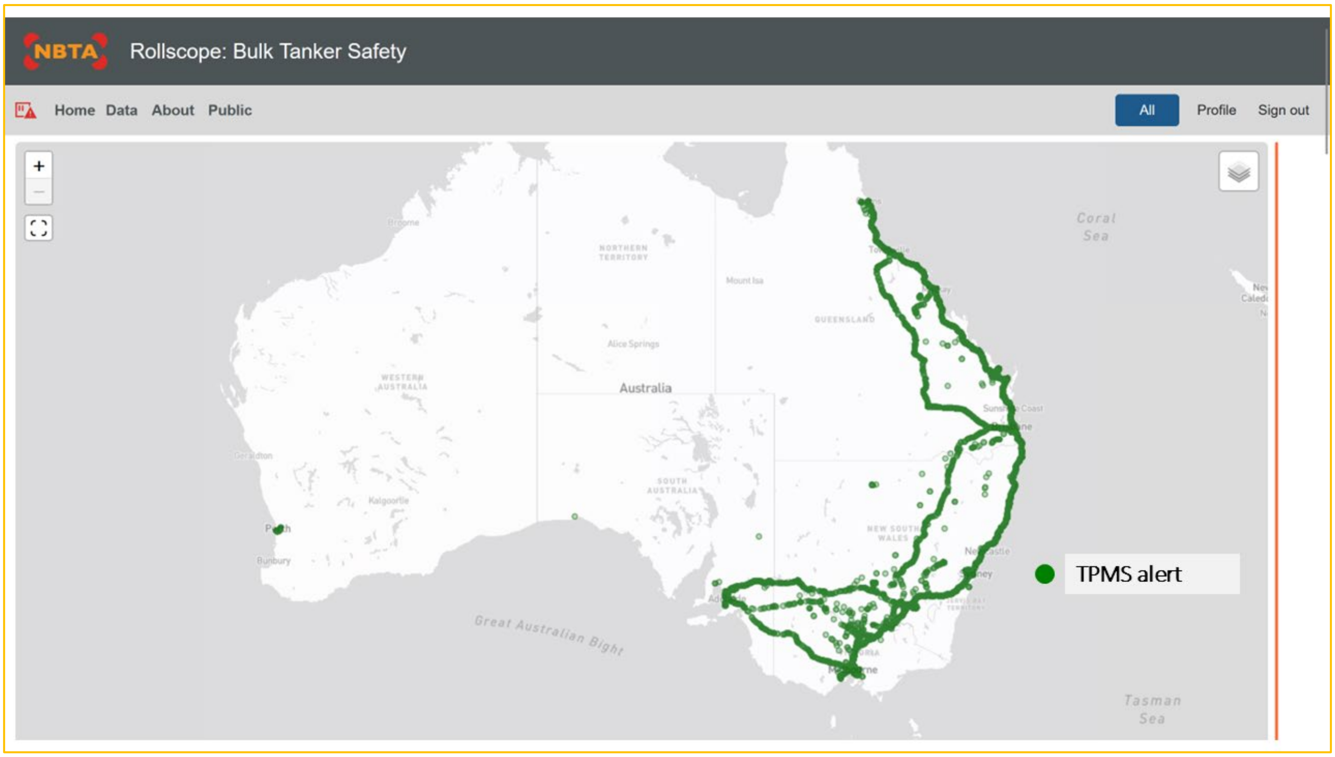
Driving Toward Safer Roads
Harness the power of near-miss data to prevent rollovers before they happen.
Open Data Dashboard
Stop Reacting—Start Preventing
Using advanced technology to transform near-miss events into actionable insights, empowering the heavy vehicle industry to eliminate rollovers and save lives.




# Secure login credentials




NBTA
Rollscope: Bulk Tanker Safety
Home
Data
About
Public
All
Profile
Sign out
Australia
Coral Sea
Great Australian Bight
Tasman Sea
EBS red
EBS amber


NBTA
Rollscope: Bulk Tanker Safety
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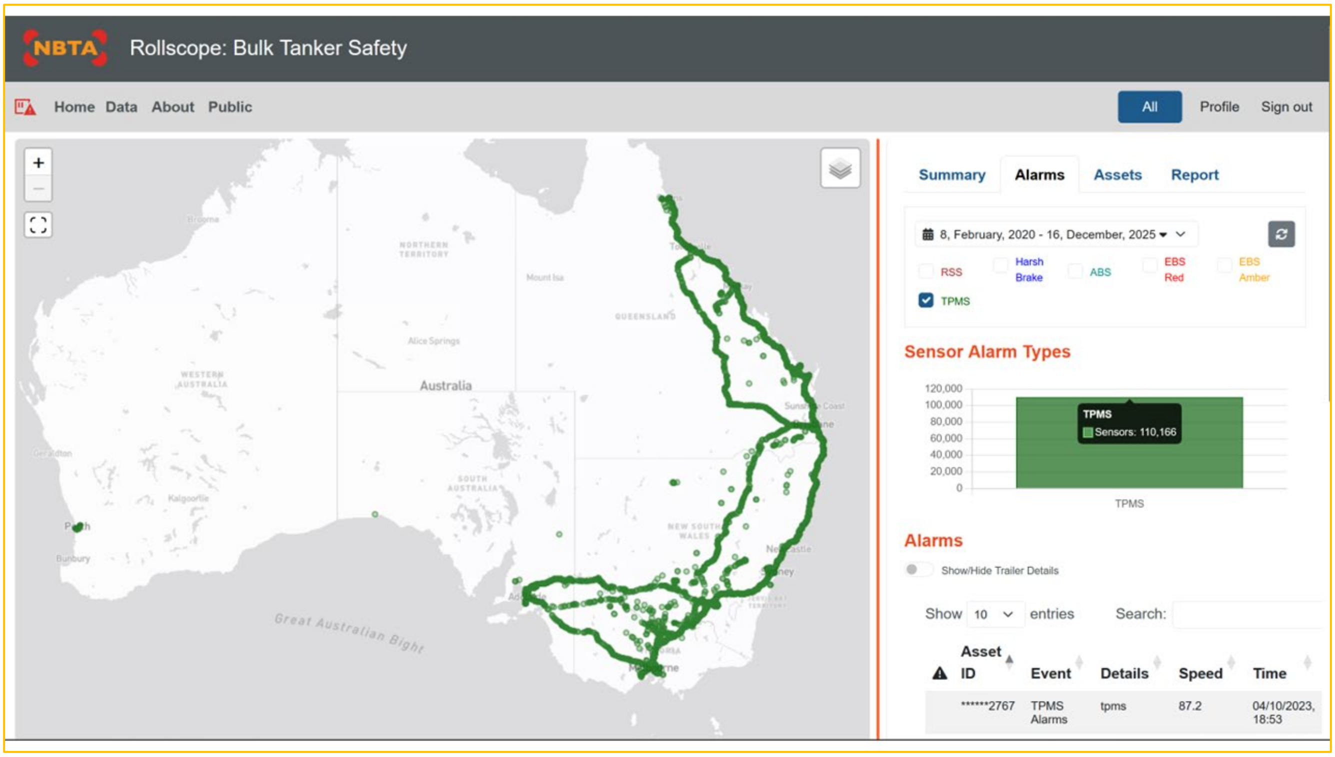
Australia
Coral Sea
Great Australian Bight
Tasman Sea
TPMS alert



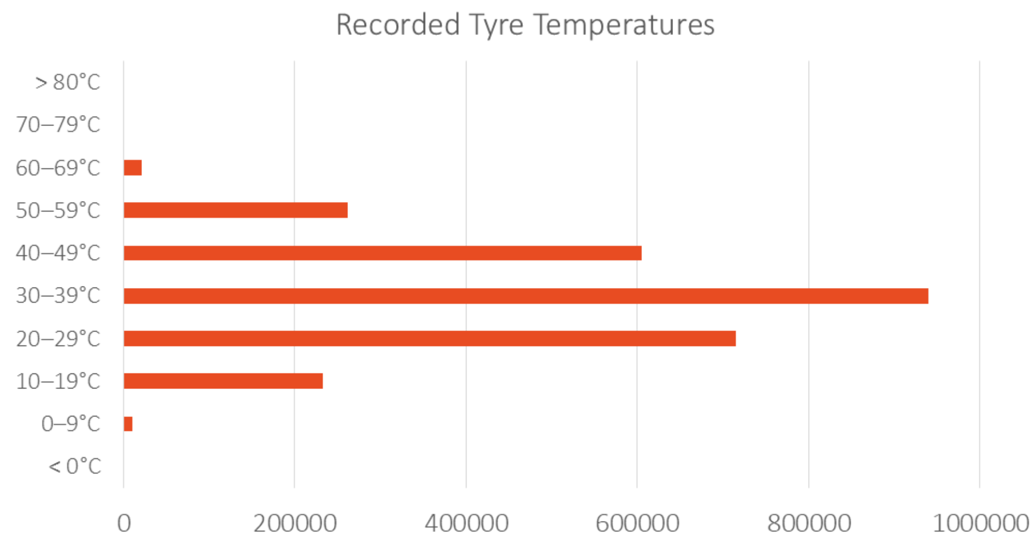

## Key statistics

| | |
|---|---|
| Start Date | 30 Sep 2023 |
| End Date | 08 Dec 2025 |
| Number of days | 801 days |
| Total EBS records collected | 3,441,182 |
| EBS records with TPMS | 591,149 (17%) |
| Total wheel TPMS records | 4,205,389 |

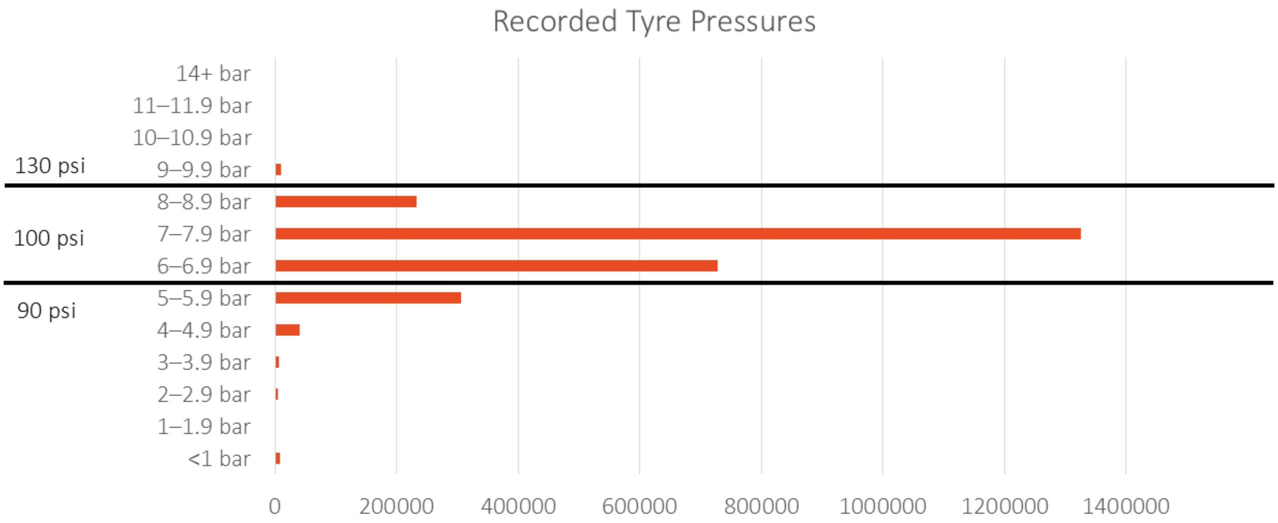
# Key statistics

| | |
|---|---|
| Trailers | 222 |
| Number of sensors (min) | 1 |
| Number of sensors (max) | 13 |
| Number of sensors (av) | 8 |
| Averge records each day | 970 |

# Tyre temperature data



# Tyre pressure data




# Duals: inner vs outer tyres

| Metric | Inner Tyres | Outer Tyres |
|---|---|---|
| Data Readings | 990,048 | 3,214,433 |
| Average Pressure | 96 psi | 103 psi |
| Median Pressure (psi) | 96 psi | 106 psi |
| Low-Pressure Rate (<70 psi) | 3.1% | 1.9% |
| Average Temperature | 30°C | 36°C |
| Median Temperature | 30°C | 36°C |
| Maximum Temperature | 67°C | 78°C |
| Error Count | 278,684 | 1,168,342 |
| Error Rate | 28.15% | 36.35% |

## Duals: inner vs outer tyres

**Pressure Differences**

- Outer tyres run consistently higher pressures than inner tyres (median 106 psi vs 96 psi).
- Inner tyres have a significantly higher low-pressure rate: 3.10% vs 1.93%.

As expected, an under-inflated inner tyre is harder to inspect in the field and more prone to underinflation.

## Findings & Next steps

- TPMS designed for managing tyres, not fires – needs to be set up
- You can forget “set and forget” – too much data is generated
- Vast majority of data is within expected range
- Important alerts lost amongst noise
- Further investigate cause of faults – i.e. sensor failure or out of range
- Inner and outer tyres differ in pressure and temperature

## Project partners

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BOOTH

CAMPBELL PETROLEUM DISTRIBUTORS

TOLL

ELGAS

CoogeeChemicals

endeavour
helping you on your way

EMERALD CARRYING COMPANY

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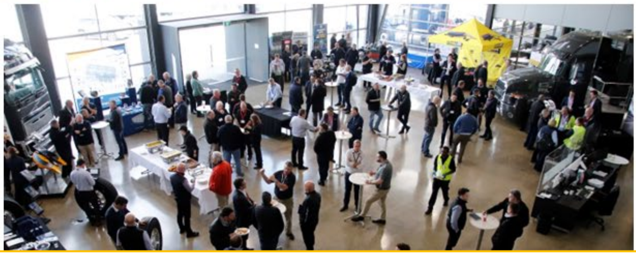

NBTA

exec@nbta.com.au