Rethinking Rail Crossing Safety and Mobility:

A Whitepaper on

Rail Crossing Information Systems

TRAINFO

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Executive Summary

Rail crossings present complex and costly safety and mobility challenges in communities across North America. Traditional infrastructure approaches like grade separations are expensive, disruptive, and slow to implement. This whitepaper introduces Rail Crossing Information Systems (RCIS) as a new and highly effective alternative that provides real-time, predictive, and integrated information to road users and emergency responders. RCIS enables cities to reduce congestion, collisions, and emergency delays at a fraction of the cost of grade separation. This paper outlines the RCIS concept, its benefits, implementation roadmap, and real-world results.

1. Understanding the Problem

Blocked and occupied rail crossings cause a wide range of societal, operational, and economic problems that extend beyond basic traffic delays. The impacts are often underestimated, yet they affect thousands of road users every day.

Key challenges include:

- **Traffic Congestion:** Trains that block crossings create traffic backups that can extend across multiple intersections and disrupt network-wide traffic flows.
- **Collision Risks:** Drivers may engage in risky behavior, such as trying to beat the train or violating warning signals.
- **First Responder Delays:** Blocked crossings delay ambulances, fire trucks, and police, which can lead to increased property damage and higher fatality rates in critical situations.
- **Public Complaints:** Citizens often express frustration about perceived inaction, which can erode trust in government agencies.

Despite installing standard safety devices like flashing lights, bells, and gates (FLBG), these problems persist. Grade separation has been the go-to recommendation, but it often proves infeasible due to high costs (often $30–$100M per site), lengthy timelines (5–10 years), and potential community disruption.

Many cities and counties feel stuck between ineffective solutions and unaffordable ones.

The Hidden Crisis at Rail Crossings

Rail crossings are an overlooked but urgent public safety and mobility issue across North America. While major crashes and derailments draw headlines, the more frequent and persistent challenge occurs at the thousands of locations where railroads and roadways intersect—often with tragic consequences.

On average, there is a collision at a rail crossing every 3 hours. Each day, at least one person loses their life as a result. These incidents are not confined to rural or poorly equipped areas—**approximately 2/3 of all rail crossing accidents occur at locations already outfitted with active warning devices** like flashing lights, bells, and gates. Even with these systems in place, 25% of all accidents happen because drivers are trying to outrun the train. This data points to a sobering conclusion: **traditional infrastructure alone is not enough.**

What's more troubling is that **progress has stalled**. Between 1981 and 2000, annual rail crossing collisions fell from 9,461 to 3,502—a remarkable **63% decrease**, averaging about **5% improvement per year**. But in the last 15 years, that momentum has completely disappeared. Instead of continued reductions, the number of incidents has held steady or even risen, with an average **1% annual increase** in recent years.

Meanwhile, the operational landscape is becoming more complex. **Train lengths have increased by 25% between 2008 and 2018**, meaning longer blockages, more traffic disruption, and greater risk at crossings. Public frustration is rising as well: **complaints about blocked crossings have more than doubled in just five years**, from 10,405 in 2020 to 26,729 in 2024.

This convergence of **persistent collisions, longer trains, and growing public dissatisfaction** highlights a critical gap: existing tools—while necessary—are no longer sufficient. To reduce risk and improve traffic flow, cities and agencies need a smarter, scalable solution that adds a layer of intelligence and communication to crossings. That's where **Rail Crossing Information Systems (RCIS)** come in.

Every 3 hours there's a rail crossing collision

2/3 of collisions occur at active crossings

Trains are 25% longer today than 2008

Blocked crossing complaints have doubled in last 5 years

2. What is a Rail Crossing Information System?

An RCIS is an end-to-end system that uses rail crossing data, predictive analytics, and real-time communication to deliver useful, actionable information about rail crossing activity to road users and emergency responders.

Key components include:

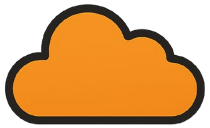
- **Rail Crossing Data:** Information about the activation status of a rail crossing or the location, speed, and direction of a train.
- **Predictive Analytics:** Algorithms that forecast crossing activations & durations.
- **Communication Systems:** APIs and data feeds that deliver information to:
  - Roadside dynamic message signs (DMS)
  - Static signs with flashing beacons
  - Mobile navigation apps (e.g., Waze)
  - Advanced Traffic Management Systems (ATMS)
  - Computer-Aided Dispatch (CAD) for 911 services
  - Public-facing 511 systems

What an RCIS Does:

- ✓ Notifies drivers of current and upcoming crossing blockages
- ✓ Guides alternate route choices where applicable
- ✓ Supports emergency route selection for 911 dispatchers
- ✓ Reduces the number and severity of traffic collisions at crossings
- ✓ Informs long-term transportation planning and investment

An RCIS provides a complete operational picture, allowing cities to turn rail crossing uncertainty into predictable, manageable events.

Data: Train detection sensors installed off rail ROW



Analytics: Cloud-based analytics predict crossing activations

Communications: Information delivered to signs, apps, traffic management centers, 911 dispatchers, and more

RCIS Within the 3E's Framework for Rail Crossing Safety and Mobility

Efforts to improve safety and mobility at rail crossings are traditionally organized under the "3E's" framework: **Engineering**, **Education**, and **Enforcement**. Each pillar addresses a different aspect of risk mitigation and operational efficiency. While Education focuses on raising public awareness and Enforcement ensures compliance with laws and regulations, Engineering applies physical and technological solutions to reduce conflicts between rail and road users.

Within the **Engineering** pillar, a variety of countermeasures are deployed to improve safety and reduce delays at grade crossings. These include:

- **FLBG (Flashing Lights, Bells, and Gates):** Standard active warning devices that alert drivers to an approaching train.
- **Channelization and Pavement Markings:** Measures such as medians, bollards, and dynamic envelopes that discourage unsafe movements around gates and clarify safe zones for drivers.
- **Traffic Signal Coordination:** Tools like pre-emption, pre-signals, and queue cutters that help synchronize highway signals with rail activity to prevent vehicle queuing on tracks.
- **Grade Separation:** The most robust solution—physically separating road and rail traffic through overpasses or underpasses.

Rail Crossing Information Systems (RCIS) complement these traditional engineering treatments by providing *real-time*, *location-specific*, and *actionable* information to drivers and traffic management systems. RCIS is not a substitute for infrastructure improvements, but a *force multiplier* that enhances the effectiveness of existing treatments. For example, RCIS can:

- ✓ Inform drivers about actual train arrival and departure times, reducing uncertainty and the temptation to circumvent gates.
- ✓ Enable dynamic signal timing adjustments based on train activity to minimize vehicle queues and delays.
- ✓ Support emergency services and public safety by providing accurate, live information about rail crossing blockages.

By integrating seamlessly with other engineering interventions, RCIS offers a cost-effective and scalable approach to managing the operational challenges posed by at-grade crossings. It helps cities and agencies make smarter use of their infrastructure investments while advancing the shared goals of the 3E's—enhanced **safety**, improved **mobility**, and better **compliance** at rail crossings.

Engineering

Rail crossing warning devices	****NEW** Rail crossing information systems**	Channelization & pavement markings	Traffic signals	Grade separation
Crossbucks Flashing lights Bells Gates	**Signs Apps 911 maps CV/AV**	Bollards Medians Dynamic envelopes	Pre-emption Pre-signals Queue cutters	Underpasses Overpasses

3. How an RCIS Differs from Train Detection

A common misconception is that a Rail Crossing Information System (RCIS) is simply a train detection sensor. While train detection plays a role in RCIS, it represents only a fraction of what a true RCIS encompasses. Understanding the differences between the two is essential for appreciating the value an RCIS delivers.

Train Detection Sensors These sensors typically consist of devices that identify the presence of trains at or near a crossing. While they can be helpful for basic awareness, they are limited in the following ways:

- ✘ **No Prediction:** They only detect trains when they are already at the crossing, leaving no time for advance action.
- ✘ **Isolated Functionality:** Detection data is often siloed and not shared with other transportation or emergency response systems.
- ✘ **Lack of Context:** Detection doesn't provide information about how long a crossing will be blocked or how traffic patterns will be affected.
- ✘ **Minimal Integration:** These devices rarely interface seamlessly with roadside signs, traffic control systems, or 911 dispatch.

RCIS: A Complete Operational System RCIS builds upon train detection but adds multiple layers of value that turn passive data into real-time decision-making tools:

- ✓ **Predictive Capability:** RCIS forecasts not just the presence of a train, but the duration of the blockage and when it will end. This foresight is essential for re-routing vehicles and selecting emergency response paths.
- ✓ **Traffic Impacts:** RCIS can determine the impact that blocked and occupied crossings have on traffic delays. This information helps drivers know how long they will be delayed, not simply how long the train will be occupying the crossing.
- ✓ **Integrated Communications:** RCIS systems distribute information to multiple platforms — including roadside signage, navigation apps, traffic management centers, and emergency response systems — so users receive it where and when they need it.
- ✓ **Operational Intelligence:** RCIS includes analytics dashboards for real-time monitoring and historical reporting, empowering agencies to plan and prioritize interventions.
- ✓ **Long-Term Support:** Vendors like TRAINFO provide continuous updates, performance monitoring, diagnostics, and customer support to ensure long-term effectiveness.

In Summary: Train detection is a useful input. RCIS is the system that turns that input into action. By enabling prediction, integration, and communication, RCIS transforms raw data into operational intelligence that benefits every user on or around the roadway. For transportation and emergency agencies, the choice isn't between detection and RCIS — it's between data and meaningful outcomes.

Train Detection vs RCIS

More than simply train detection, an RCIS provides an effective end-to-end solution specifically designed for the unique features of rail crossings.

	Train Detection	RCIS
Determine if crossing is blocked	✓	✓
Predict when crossing will be blocked	✗	✓
Out-of-the-box analytics	✗	✓
Integration into signs, apps, ATMS, CAD	✗	✓
Monitoring and updates	✗	✓
Ongoing support	✗	✓

Why Train GPS Data Is Not a Feasible Solution

While it may seem logical to use train GPS data from railroads to predict or monitor rail crossing activity, this approach is highly problematic in practice. Public agencies considering this path face serious limitations—both legal and technical—that significantly reduce its reliability, coverage, and usability.

INCOMPLETE COVERAGE DUE TO TRACKAGE RIGHTS

Many rail corridors are shared by multiple railroads through arrangements known as *trackage rights*. Unless data is obtained from **every** railroad operating on a shared track, public agencies will lack a complete picture of train movements. This results in missing critical blockage events and leaves gaps in situational awareness, undermining the reliability of any system built on partial data.

LEGAL AND CONTRACTUAL BARRIERS

Accessing GPS data from freight railroads often requires extensive legal negotiations. Railroads are private entities with proprietary concerns and may impose strict conditions on data sharing—if they allow access at all. Negotiating these agreements can take years and may result in restrictions that severely limit the usefulness of the data.

NO INSIGHT INTO CROSSING MALFUNCTIONS

Train GPS data does not detect or explain malfunctions of crossing infrastructure—such as gates stuck in the down position—which still cause major traffic delays and safety issues. Without direct monitoring of the crossing itself, key failure modes remain invisible.

TECHNICAL COMPLEXITY AND LACK OF STANDARDIZATION

Even if access is granted, the technical barriers are likely substantial. Railroads may use different data formats, update intervals, and GPS accuracy standards. Public agencies would be responsible for converting disparate data sources into a uniform, reliable format—an effort that requires significant investment in IT infrastructure and ongoing maintenance.

RESTRICTIONS ON USE, STORAGE, AND REPORTING

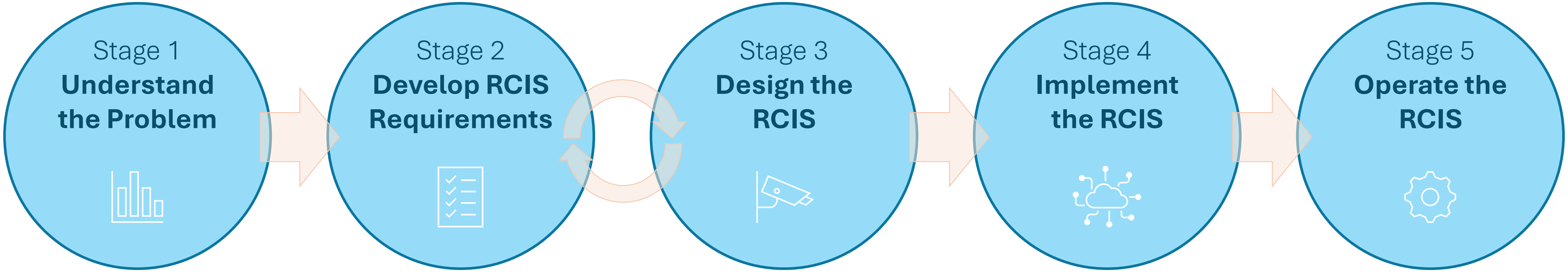
Even with access to the data, agencies may be limited in what they're allowed to do with it. Railroads often prohibit long-term storage, detailed historical analysis, or integration into broader traffic management systems. These restrictions significantly reduce the data's strategic and operational value.

POOR VISIBILITY OF SWITCHING AND SHUNTING MOVEMENTS

Train GPS data typically lacks precision in low-speed switching or yard operations—exactly the kinds of movements that can block crossings for extended periods without being reflected accurately in GPS signals. These activities are common in urban areas and can cause some of the most unpredictable and frustrating delays.

Bottom line: Train GPS data is not a viable foundation for a rail crossing information system. A purpose-built RCIS—using trackside detection, predictive analytics, and direct integration with traffic systems—offers a far more accurate, scalable, and agency-controlled solution for improving safety and mobility at rail crossings.

4. The 5 Stages of Implementing an RCIS



Quantify congestion, accidents, 911 delays

This step ensures you are targeting the right issues in the right places. Plus, it can help you build the business case and get funding.

Questions to answer:
- Which crossings and streets are impacted?
- What is the magnitude of these impacts?
- Who's impacted and when?

Determine solution & performance specs

This step informs technology selection, scope, and budget. It's often iterative with Stage 3.

Questions to answer:
- What level of improvement is desired?
- How much budget is available?

Select technologies and locations

This step selects technologies and develops the installation plan to meet system requirements. It's often iterative with Stage 2.

Questions to answer:
- How am I getting rail crossing information data?
- Where can I install sensors and signs?
- Where do I need to deliver this information?

Install the system and complete integrations

This step involves installing equipment in the field, calibrating sensors, and integrating the system into third-party applications.

Questions to answer:
- Who's responsible for field installation?
- Which third-party systems need integrations?

Operate and maintain system

This step involves preventing system failures, updating software, maintaining security credentials, and sustaining integrations.

Questions to answer:
- Who's responsible for ensuring system uptime?
- Who's responsible for system updates?
- Who's responsible for monitoring integrations?

5. Cost-Effectiveness and Benefits

Problem	<$100k per crossing		$100k-$1M per crossing		>$1M per crossing
	RCIS	Channelization	FLBG	Signals	Bridge
Traffic congestion	✓	✗	✗	✗	✓
Drivers violating warning	✓	✓	✗	✓	✓
Drivers speeding to beat train	✓	✗	--	--	✓
First responder delays	✓	✗	✗	✗	✓

RCIS costs typically range from $5K–$10K per crossing per year — less than 1% of the cost of grade separation. It is also scalable, enabling jurisdictions to address dozens of crossings instead of just one.

Performance results from deployments include:

- Up to **30% reduction** in traffic delays
- Up to **22% reduction** in collision risk
- Up to **91% reduction** in 911 response delays
- Significant **decline in driver violations**
- High **public satisfaction** and reduced complaints

RCIS vs Grade Separation: A Scalable Path to Safety

Improving safety at rail crossings is a critical national priority, and funding decisions must balance impact, cost, and scale. Grade separation is often seen as the gold standard—but it comes with significant financial and logistical barriers. Rail Crossing Information Systems (RCIS), by contrast, offer a highly scalable alternative that delivers meaningful safety outcomes at a fraction of the cost.

Comparative Impact: Same Budget, Very Different Results

How a hypothetical **$1 billion USDOT investment** could be used for RCIS vs grade separation:

	RCIS	Grade Separation	
Total Budget	$1,000,000,000	$1,000,000,000	Same investment
Cost per Crossing (10-year lifecycle)	$312,500	$50,000,000	RCIS cost based on TRAINFO deployments (including signs); Grade separation costs reflect urban projects
Number of Crossings Improved	3,200	20	RCIS improves **160x** more crossings
Collisions Predicted at Treated Crossings (over 10 years)	7,837	253	Based on Federal Railroad Administration GXAPS data
Collision Reduction Rate	22%	100%	Grade separation eliminates risk; RCIS reduces it
Collisions Prevented	1,724	253	RCIS prevents nearly **7x** more collisions

With the same $1 billion investment, **RCIS can prevent nearly 1,500 more collisions** than grade separation by addressing safety at a much larger number of crossings. While grade separation eliminates risk at a small number of high-priority sites, RCIS provides a broader, more cost-effective safety net—especially critical in areas where grade separation is not practical.

This is not an either-or choice. Grade separation will always be essential in some locations. But to scale safety nationwide, **RCIS offers an immediate, proven, and cost-efficient path forward**.

6. Case Studies and Results

Chattanooga, TN

Reducing Congestion and Improving Safety

The City of Chattanooga implemented TRAINFO's RCIS at two major crossings near the Norfolk Southern DeButts Yard, where frequent train activity caused significant delays. With no budget for grade separation, the city deployed predictive train sensors and Dynamic Message Signs to inform and reroute drivers in real time. **The result: a 25% reduction in delayed vehicles, over 90% prediction accuracy for train arrivals and clearances, and fewer risky driver behaviors.** Chattanooga's success demonstrates how RCIS can reduce congestion and improve safety at high-impact crossings—quickly and affordably—without requiring coordination with the railroad.

Charleston County, SC

Enhancing Emergency Response

Charleston County partnered with TRAINFO, RapidDeploy, and Skyline to overcome emergency response delays caused by blocked rail crossings. TRAINFO's sensors predicted train blockages up to 10 minutes in advance and integrated with RapidDeploy's 911 mapping platform. This allowed dispatchers to reroute emergency vehicles in real time, avoiding delays and improving response times. **The system reduced train-related emergency delays by 91%, with at least one unit rerouted daily.** Charleston's approach illustrates how RCIS can enhance situational awareness, coordination, and routing for emergency services—especially in areas with constrained access and complex transportation networks.

New Haven, IN

A Scalable Solution for Small Cities

New Haven, Indiana, faced daily traffic backups and emergency delays at key crossings, including one on a primary 911 route. **Without the resources for grade separation, the city implemented TRAINFO's RCIS to provide real-time train detection, predictive alerts, and driver messaging through roadside signs.** The system gave emergency responders the advance warning they needed to reroute and improved traffic conditions citywide. New Haven's success shows that RCIS works in communities of all sizes, with fast deployment, low cost, and no need for railroad approval—making it an ideal solution for small and mid-sized cities.

7. Common Misconceptions About RCIS

Despite its proven impact on rail crossing safety and mobility, Rail Crossing Information Systems (RCIS) are often misunderstood. Below are some of the most common misconceptions—and why they don't hold up.

"RCIS is just train detection."

False. Train detection is only one part of the equation. What makes an RCIS effective is its ability to *predict* train arrival and departure times, *integrate* with traffic signals and roadside signs, and *support* traffic management centers and public safety responders. It's the system's intelligence and connectivity—not just the sensors—that deliver real value.

"We can just use rail schedules or pre-emption data."

Rail schedules are rarely accurate enough for real-time applications. Freight trains especially are unpredictable and can arrive early, late, or not at all. Pre-emption signals, while useful, only activate once a train is already near the crossing. They provide no predictive insight and no information about blockage duration. Neither option comes close to replacing a full RCIS.

"Grade separation is the only real solution."

Grade separation is a gold standard—but it's also expensive, time-consuming, and often not feasible. RCIS addresses many of the same challenges, such as reducing delays, driver frustration, and emergency response conflicts, at a fraction of the cost and with much greater flexibility and speed of deployment.

"There are no re-route options, so RCIS won't help."

Even when detours aren't available, RCIS still improves outcomes. It reduces risky behavior like gate running and U-turns, gives drivers more accurate expectations for wait times, enhances emergency response routing, and builds public trust by showing that the city is actively managing crossings with real-time tools.

"We can build this in-house for less."

Most in-house attempts underestimate the complexity of an effective RCIS. It's not just about hardware—it requires accurate train prediction models, robust system reliability, seamless integration with signal infrastructure, and ongoing maintenance and updates. DIY solutions often result in poor accuracy, long-term maintenance challenges, and ultimately higher costs due to system failures or lack of adoption.

8. About TRAINFO

More than simply train detection, TRAINFO provides an effective end-to-end solution specifically designed for the unique features of rail crossings.

Specialized train detection sensors with 99.99% accuracy that are installed **off rail property**

Patented processes that provide train movement **predictions**

Out-of-the-box **analytics** dashboards for transportation and 911

Seamless **integrations** into roadside signs, traffic management centers, mobile apps, 911 software, and more

24/7 remote **monitoring** and regular software updates to ensure system uptime and performance

A dedicated customer **support** expert to guarantee your satisfaction

Up to **30%** reduction in congestion and collision risk & **91%** reduction in 911 delays

Less than **1%** of the cost of grade separation & eligible for FHWA Section 130 funding

Conclusion

RCIS represents a paradigm shift in how cities address traffic and safety challenges at rail crossings. Instead of relying solely on costly, disruptive infrastructure projects, agencies can now deploy intelligent systems that provide measurable benefits quickly and affordably.

With proven success in cities of all sizes, RCIS empowers transportation and emergency managers to make data-driven decisions, respond to public needs, and ensure the safety and mobility of their communities.

It's time to rethink how we manage rail crossings — and RCIS is the smarter path forward.

To learn more or get started with an RCIS in your community, contact TRAINFO or visit www.trainfo.ca.