TRAINFO reduces traffic delays at rail crossings by 30%

TRAINFO

City of Vancouver Case Study

TRAINS CAUSING TRAFFIC DELAYS IN VANCOUVER

In 2017 the City of Vancouver began noticing a sudden, unexpected, and significant increase in rail activity in the downtown area. One location that was impacted the most was the Venables St rail crossing. The Venables St corridor is one of three major east-west arterials serving downtown Vancouver. During peak periods traffic volumes can reach 2,000 vehicles per hour per direction on this 4-lane arterial. For decades, this crossing experienced about one train per month. Virtually overnight, train activity increased to 10 per day with many long and slow-moving trains. Although the City had long-term plans to construct grade separations and by-passes in the area, these improvements were unlikely to be completed in the next 15-20 years.

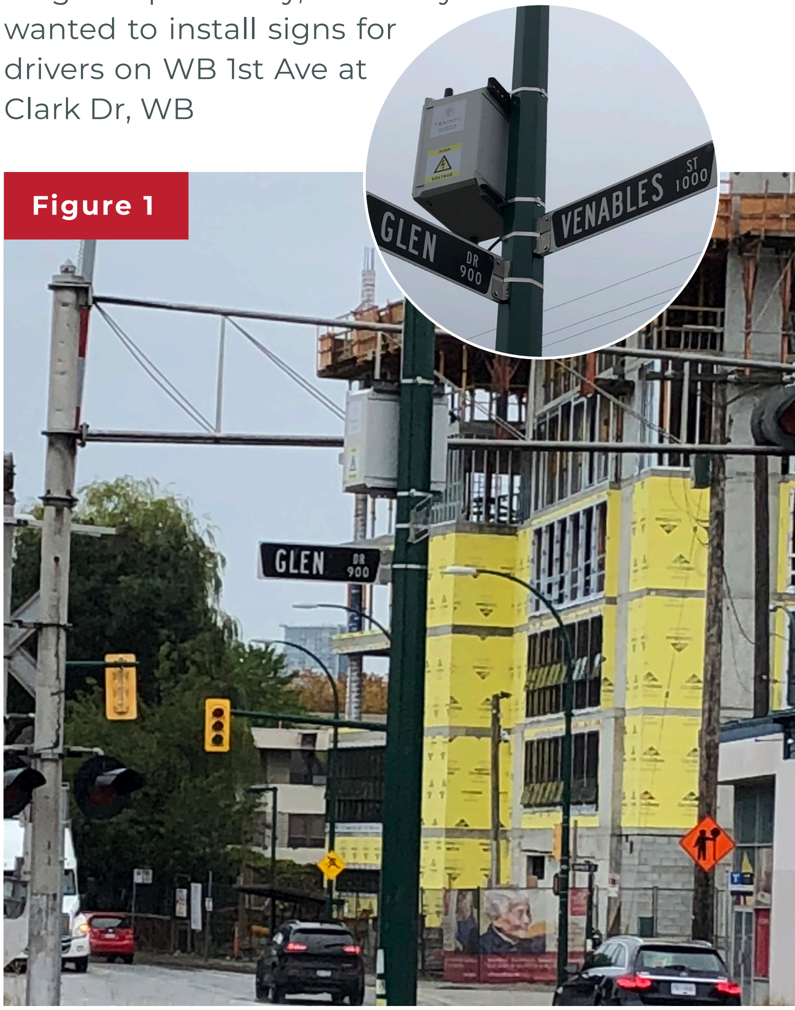
The City needed a solution to help drivers re-route around the Venables St crossing in a way that reduced delays on the corridor but also mitigated traffic congestion across the entire road network surrounding the rail crossing. Specifically, the City wanted to implement a traveler information system that helped drivers re-route when the crossing was blocked. Initially the City planned to develop this system internally but faced insurmountable challenges in obtaining accurate real-time and predictive train information. The City attempted to collect this data with video and other vehicle detection technologies and discovered that these approaches were costly, unreliable, and/or inaccurate and required significant staff time and manual efforts to operate and manage.

VANCOUVER USES TRAINFO TO RE-ROUTE TRAFFIC AROUND TRAINS ON VENABLES ST

Instead of trying to create a system from scratch or hiring a contractor to design and build one with off-the-shelf technologies, the City of Vancouver implemented TRAINFO's out-of-the-box rail crossing information system. This system involved installing train sensors along the rail line, installing Bluetooth traffic monitoring sensors on roads surrounding the rail crossing, analyzing train and traffic data to predict delays on Venables St due to trains, and delivering this information to drivers to help them re-route.

First, TRAINFO reviewed the area with City engineers to understand the problem and desired solution. Ultimately, the City wanted to provide information to drivers to select the fastest route when Venables St was blocked by a train. They wanted to use dynamic message signs at key locations to notify drivers when the crossing was blocked and how much delay to expect, because sometimes re-routing around the train would take longer. Specifically, the City wanted to install signs for drivers on WB 1st Ave at Clark Dr, WB

Figure 1



Hastings St at Clark Dr, and EB Georgia St at Hamilton St about delays. Since these signs were up to 2.5 km from the Venables crossing, drivers needed predictive information about the delay they would experience once they arrived at the crossing and not the delay that drivers already at the crossing were experiencing.

Next, TRAINFO worked with City engineers and technicians to identify poles for installing train and traffic sensors and DMS board locations. An important aspect of TRAINFO's system is that it is implemented entirely off rail right-of-way and does not require any input or approvals from railroads. We used Google Streetview to identify candidate poles for which to install the train and Bluetooth sensors and assess potential locations for signs. Candidate poles for the train sensor included any pole within 100 feet of the crossing and with 120 VAC power supply for the sensor. Figure 1 shows the train sensor installed on a light standard next to the Venables rail crossing. Bluetooth sensors were installed on traffic signals, which created three origin-destination pairs: A-B-C, D-C-B, and E-C-B (refer to Figure 2). A total of 2 train sensors, 5 Bluetooth sensors, and 3 DMS boards were installed, as shown in Figure 2. Historical HERE Maps data was used to estimate expected travel time between origin-destination pairs and Bluetooth sensors were used to calculate actual, real-time travel time between each O-D pair.

TRAINFO delivered the sensors and signs for City technicians to install. Sensor installation required two electricians and a boom truck and took about one hour per location to complete. The sensors

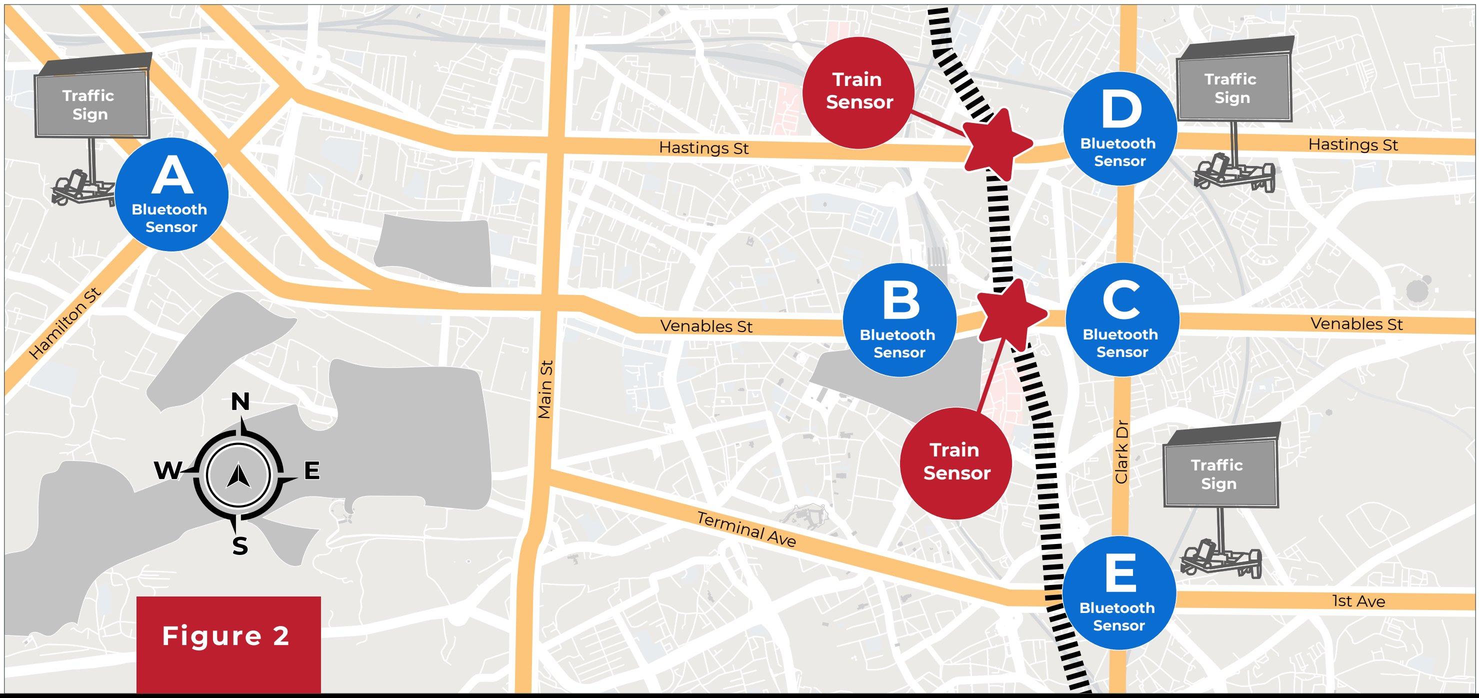


Figure 2

used direct power from the poles and had a backup battery to provide up to 2 days of operation if needed. Once the technicians turned on the sensor, a wireless signal was sent to TRAINFO to confirm that it was operational. After receiving this signal, TRAINFO initiated its remote calibration process and after 5 weeks the system was ready to use.

The exact sign location, sign type, and dimensions were based on available right-of-way and the message provided to drivers. Due to limited ROW, the City chose portable, solar-powered DMS boards with wireless communication capabilities.

As part of the system, TRAINFO also provided an interactive online data portal that provided detailed blocked crossing and traffic delay information (as shown in Figure 3). This enabled the City to understand exactly when rail crossings were blocked and how much delay blockages were causing. Further, the City could download the data as a .csv file and conduct their own detailed analyses. This data facilitated before-and-after studies and supported traffic modeling to evaluate the benefit of adding signs to other locations.

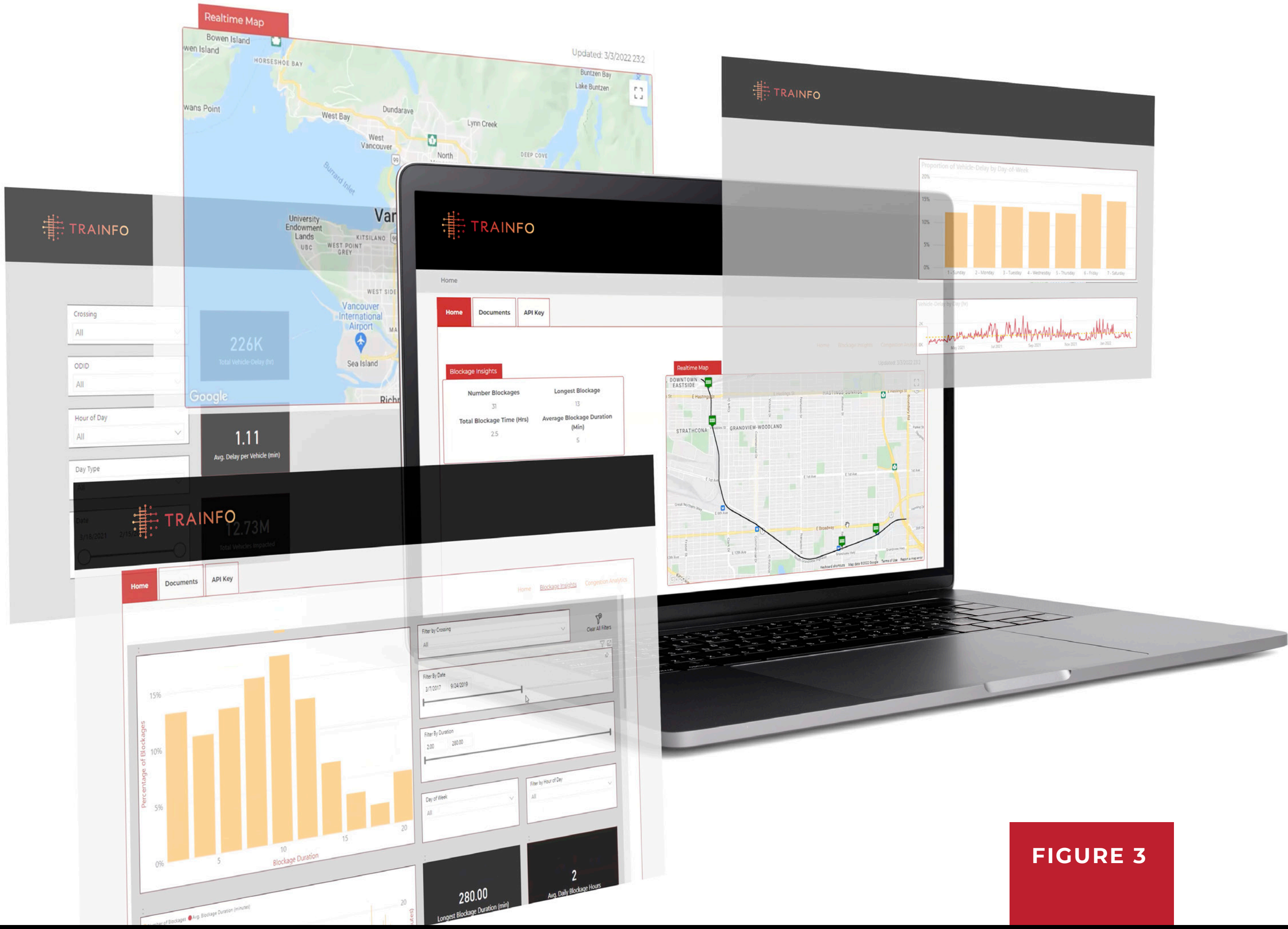


FIGURE 3

TRAINFO REDUCES TRAFFIC DELAYS CAUSED BY TRAINS BY 30%

Train and Bluetooth sensors were installed in March 2021 and the DMS boards were installed on July 30, 2021. To evaluate the benefit of the traveler information system, TRAINFO compared 2 months of rail crossing and travel time data before DMS board installation (from May 1, 2021 to June 30, 2021) and 2 months of data after sign installation (from September 1, 2021 to October 31, 2021). Figures 4, 5, and 6 summarize train activity at the Venables crossing between May 1, 2021 and October 31, 2021. The Venables crossing averaged 17 trains per day with a maximum of 36 trains on two separate days. The average blockage duration was 6 minutes and the longest was 70 minutes. On average, Venables St was blocked for 2 hours per day and nearly 50% of blockages were 10 minutes or longer.

To assess the benefit of the sign, TRAINFO used HERE data to determine expected travel time profiles for each origin-destination pair for various crossing blockage durations. For example, we determined what the travel time for O-D pair A-C was when there was a 1-minute blockage, 2-minute blockage, etc. These profiles provided the expected travel time without the sign. This process resulted in a matrix of expected travel times and blockage durations; i.e., the base scenario. After installing the sign, TRAINFO used Bluetooth sensors to measure the actual travel time for various blockage durations and compared these to the expected travel time from the base scenario matrix.

TRAINFO WAS ABLE TO REDUCE TRAFFIC DELAY BY 30% AND VEHICLE EXPOSURE TO TRAINS BY 22%.

Table 1 summarizes the before-and-after results of the sign, including the reduction in traffic delay and vehicle exposure at the rail crossing. Before the sign, 180,660 trips were impacted by the train, resulting in 7,507 hours of delay. After the sign, 140,519 trips were impacted by the train, resulting in 5,275 hours of delay. Therefore, TRAINFO was able to reduce traffic delay by 30% and vehicle exposure to trains by 22%.

Table 1

		Travel Delay Due to Venables St Blockages			Vehicles Impacted by Venables St Blockages		
Origin-Destination Pair	**Sign Location**	**Before DMS Sign (Hours)**	**After DMS Sign (Hours)**	**Reduction (Hours)**	**Before DMS Sign**	**After DMS Sign**	**Reduction (Vehicles)**
A - C	EB Georgia St @ Cambie St	2,443	1,786	657 27%	47,917	37,248	10,669 22%
D - B	WB Hastings @ Clark Dr	3,200	2,178	1,022 32%	72,949	55,578	17,371 24%
E - B	WB 1st Ave @ Clark Dr	1,864	1,311	553 30%	59,794	47,693	12,101 20%
Total		7,507	5,275	2,232 30%	180,660	140,519	40,141 22%

Number of blockages and average duration by day of week

Figure 4

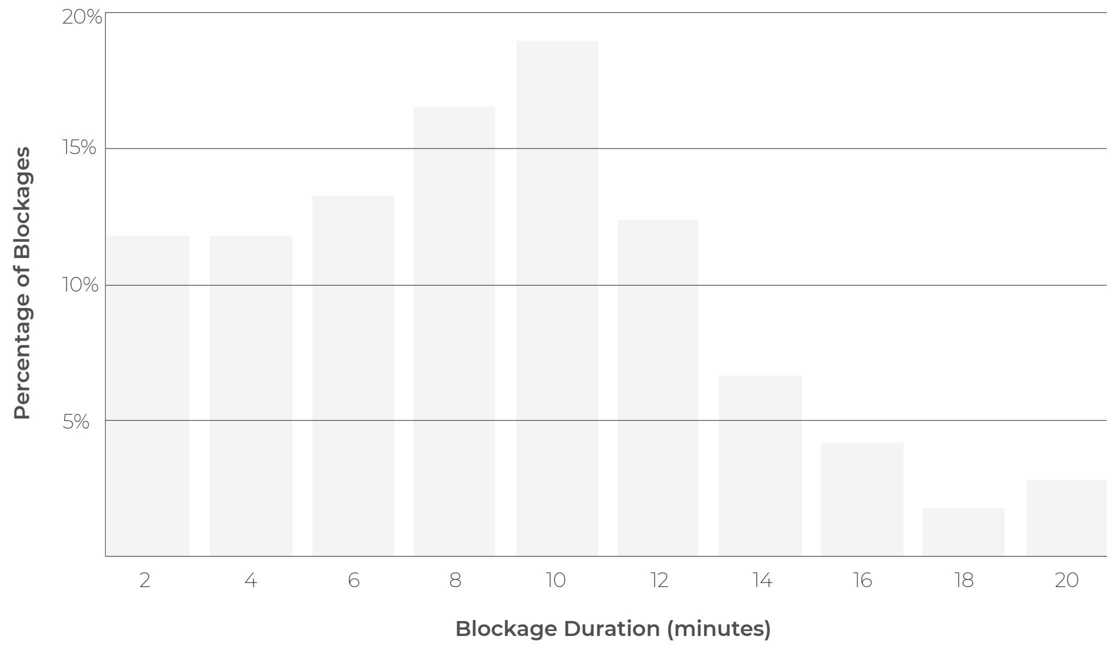
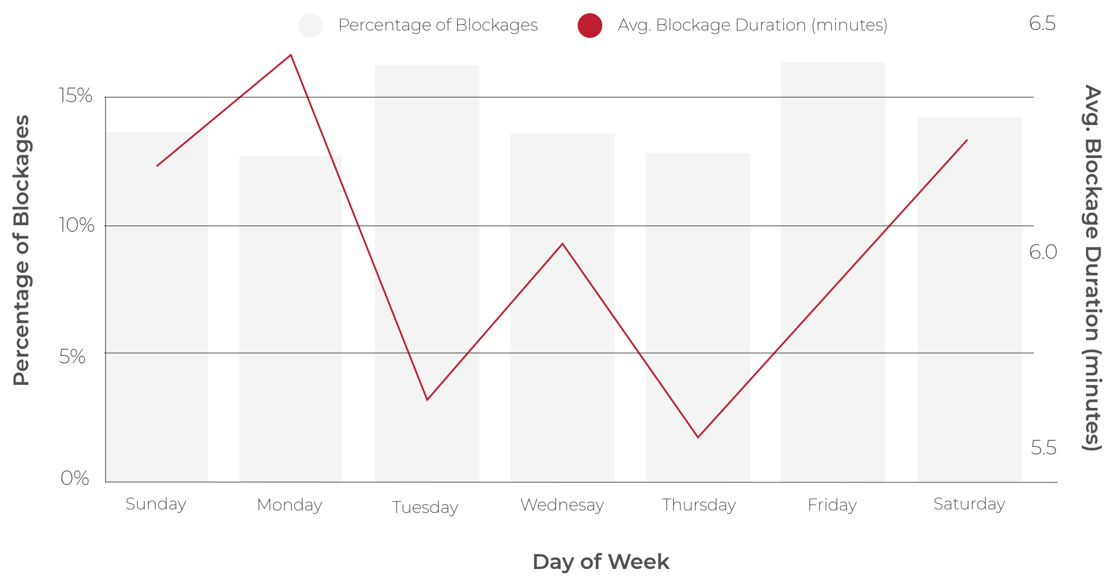
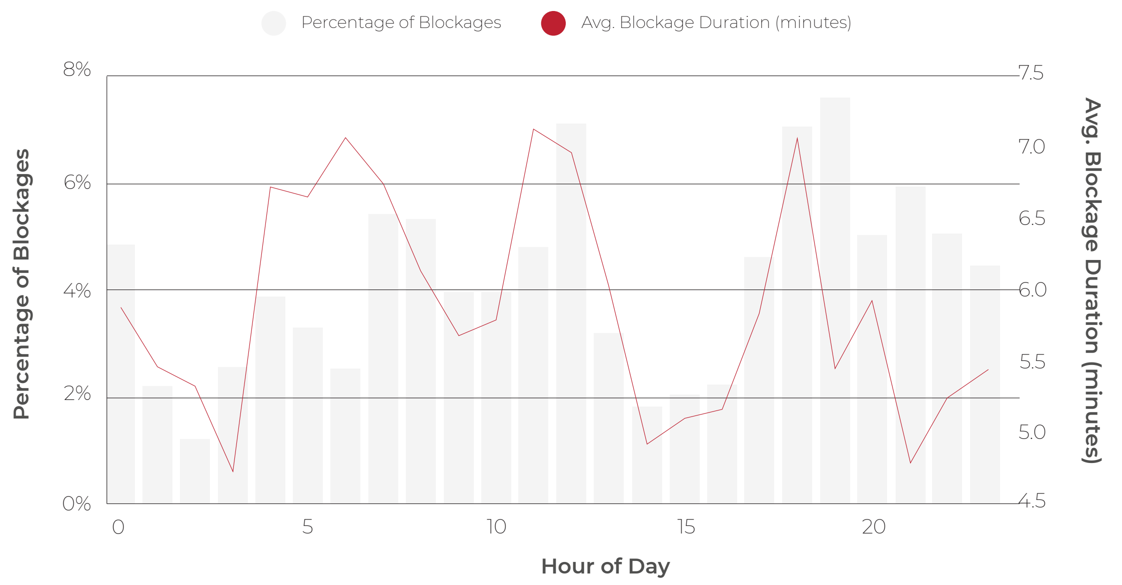


Figure 5



Blockage count and average duration by hour of day

Figure 6



TRAINFO IS 125X MORE COST-EFFECTIVE AT REDUCING DELAYS AT RAIL CROSSINGS COMPARED TO GRADE SEPARATION

In 2019, the City of Vancouver conducted a study to evaluate different options to address issues caused by the Venables rail crossing. One option was to construct an underpass. Although underpasses eliminate traffic delays caused by trains, the high cost can be prohibitive to implement. In other words, underpasses offer a very high benefit for a very high cost. The DMS signs implemented in Vancouver demonstrated substantial travel time reduction benefits for a much lower cost than underpasses. To better understand the cost-effectiveness of each option, we performed a simple analysis that compared the costs and benefits in terms of travel delay reduction over a 25-year period. Table 2 summarizes the results.

Our travel time analysis before the DMS signs, conducted over a 60-day period between May 1 and June 30, 2021, found that crossing blockages caused 7,507 hours of vehicle-delay – which averages to 125 hours per day. Assuming this delay remains constant, the crossing would cause 1,140,625 hours of delay over a 25-year period (9,125 days).

The City's study estimated the construction cost of an underpass at Venables to be $125 million*. Assuming the underpass would reduce delay by 100%, the benefit is a travel delay reduction of 1,140,625 hours and the cost is $125 million (excluding future maintenance and repair costs and time-value of money). Therefore, the cost of an underpass to reduce one hour of delay is $109.59 ($125,000,000 / 1,140,625 hours).

The 25-year cost of operating TRAINFO's system at Venables is $300,000

*Source: https://council.vancouver.ca/20191001/documents/RR1Presentation.pdf?hootPostID=b4134cf0aa93f0880ecd6312b99833f2 (excluding maintenance and repair costs and time-value of money). Assuming the signs would continue to reduce delays by 30%, the benefit is a travel delay reduction of 342,187 hours. Therefore, the cost of TRAINFO to reduce one hour of delay is $0.87 ($300,000 / 342,187 hours). This means TRAINFO is about 125 times more cost-effective than an underpass ($109.59 / $0.87) in terms of travel delay reduction.

THE COST OF TRAINFO TO REDUCE ONE HOUR OF DELAY IS $0.87. THE COST OF AN UNDERPASS TO REDUCE ONE HOUR OF DELAY IS $109.59.

Table 2

Option	Delay Before Option*	Delay After Option*	Delay Reduction	Delay Savings over 25 years^	Cost~	Cost per Hour of Delay Reduction
Underpass	7,507 hr	0 hr	100%	1,140,625 hr	$125,000,000	$109.59
TRAINFO	7,507 hr	5,275 hr	30%	342,187 hr	$300,000	$0.87

*Before represents May 1 to Jun 30, 2021; After represents Sep 1 to Oct 31, 2021
^Assumes traffic volumes and travel time are constant
~25-year cost, excluding maintenance and repair costs and time-value of money

REDUCE TRAFFIC DELAYS AT RAIL CROSSINGS QUICKLY, EASILY, AND AFFORDABLY

In the past, addressing traffic delays at rail crossings meant grade separation or rail relocation. In the rare cases where these options were even feasible, they often took years or decades to implement and required complex design and construction efforts with a price tag to match. Flashing lights, bells, and gates were installed, interconnection and traffic signal pre-emption was occasionally provided, and pavement markings and lane barriers were sometimes considered to address safety concerns. However, none of these meaningfully reduced traffic delays.

Most of the time, public agencies had to settle and accept that rail crossing issues were an unavoidable feature of the transportation system.

TRAINFO's groundbreaking technologies that use innovative train sensors and leverage the power of the cloud and machine-learning have changed the landscape. For the first time, public agencies have an affordable, effective, out-of-the-box solution to reduce traffic delays caused by trains that is quick and easy to implement at any rail crossing.

To join the City of Vancouver in reducing traffic delays at rail crossings, reach out to TRAINFO at contact@trainfo.ca and visit us at **trainfo.ca.**

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