City of Winnipeg

2019 Traffic Signals Branch Annual Report

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EXECUTIVE SUMMARY

The 2019 Traffic Signals Annual Report provides an overview of the activities of the City of Winnipeg's Traffic Signals Branch, including an introduction to the branch, key performance indicators (KPIs), and current projects.

Traffic Signals is responsible for designing, procuring, building, setting timing for, operating, and maintaining all electrified traffic displays within the city, including signalized intersections, flashing pedestrian corridors, keep-right flashers, and speed/prepare-to-stop signs. Traffic Signals also operates the Transportation Management Centre (TMC) – a real-time response unit that helps keep traffic moving and Winnipeggers informed of delays.

Traffic signals play an unusually large role in moving people and goods efficiently through Winnipeg due to the lack of freeways and the large number of railroad crossings. Furthermore, demand on traffic signal infrastructure has increased due to several factors:

1. The population of Winnipeg has grown steadily in recent years, from 677,800 in 2011 to 763,900 in 2019 (an increase of 1.5% per year).[1]
2. The total number of lane-kilometres of regional streets in Winnipeg has not increased at the same rate, increasing only 0.5% from 1,815 lane-kilometres in 2015 to 1,824 lane-kilometres in 2017.[2] All else equal, this implies more drivers pass through the same length of road, which implies more congestion.
3. The number of registered vehicles has steadily increased from 497,549 vehicles in 2011 to 569,834 vehicles in 2017. During the same period, the number of vehicles per person also increased at about 0.5% per year from 2011 to 2017.[3]

Despite these challenges, Signals has helped achieve:

4. Low traffic signal malfunction rates, including a decrease in malfunctions of 79% since 2010.
5. Quick response times to traffic signal damages and maintenance issues.
6. A threefold increase in temporary signal timing changes in response to road conditions (e.g. construction, special events) from 2017 to 2018 and a further increase of 47% from 2018 to 2019.
    - Prior to 2017, Signals did not have the capability to provide temporary timings. This will be essential to help manage traffic through high levels of construction projected by record-high road renewal funding.
7. A 33.6% reduction in 311 cases relating to signal timing from 2016 to 2019 and a 66.6% drop in the average number of days required to resolve these cases over the same period.

On top of these day-to-day operational achievements, the Branch engages in a wide variety of value-added projects. They fall into several categories:

- ***Data collection***: Gathering data that provides situational awareness that did not previously exist. Signals is currently working on developing data for traffic flow, internal operational data, among other sources.

- ***Data analysis, reporting, and automation***: Collecting data is not enough - it is crucial to also have systems in place to actually use the data in valuable ways. Some specific activities in this area include automated power

[1] https://winnipeg.ca/cao/pdfs/population.pdf (MPI Vehicle Registration 2006-2017.xlsx)
[2] https://www.winnipeg.ca/cao/pdfs/CommunityTrendsandPerformanceReportVolume1_2019.pdf, pg. 53
[3] MPI Vehicle Registration 2006-2017.xlsx

reporting to Manitoba Hydro, implementing reporting tools, developing an automated incident alert system, and publishing corridor reports.

- ***Investigating and testing new signals technologies***: Technology related to Traffic Signals is always changing and improving, which means that Signals must stay abreast of these trends and investigate the feasibility of implementing these technologies. Some examples of technologies Signals is currently researching include Circular Flashing Beacons at pedestrian crossings, different methods for cyclist detection, and peer-to-peer communication between traffic signal controllers.

- ***Improving traffic signals infrastructure***: Signals is constantly working to improve safety and efficiency of its traffic signals infrastructure through revitalization and upgrade efforts. Some notable current projects include...

- ***Partnerships***: Since the work of the Traffic Signals Branch is relevant to many stakeholders, there can be significant benefits partnering with stakeholders with shared interests. Signals cultivates partnerships interdepartmentally, as well as through universities and the private sector.

- ***Process improvement***: Signals is constantly working to improve the efficiency of internal processes, including process documentation and automating internal workflows.

TRAFFIC SIGNALS FAST FACTS

The table below provides a quick overview of the main performance indicators for the Traffic Signals Branch, comparing previous and current reporting years.

Area	Indicator		Previous Year (2018)	Current Year (2019)
Infrastructure	# Vehicle Intersections	Regular	644	651
		Half-Signal	18	18
		Flashing Red Light	6	7
	# Pedestrian Corridors[4]		182	182
	% Vehicle Intersections Equipped with Accessible Pedestrian Signals (APS)		87.8%	95.4%
	Replacement Value of Infrastructure		$36,223,372	$39,659,648
	Total Replacement Value of Infrastructure in Poor Condition		$2,260,720	$1,508,538
Operations	# Traffic Signal Malfunctions		1,334	1,255
	Average Response Time to Malfunctions (hours)		4.38	3.63
	# Traffic Signal Damages		366	372
	% Damages Recovered		58.2%	62.4%
Design	# Design Drawings Created		658	600
	# Construction Drawings without As-Built Drawings		209	229

[4] Note that 3 pedestrian corridors were converted into vehicle intersections in 2019.

Signal Timing	# Temporary Timing Changes	1,247	1,831
	# Permanent Timing Changes[5]	636	425
TMC	# Cameras in operation	160	170
	% of Regional Road Network Visible to Cameras	57.9%	60.8%
	Kilometres of Regional Road Network Visible to Cameras	544	573
	# Incidents in TMC Incident Manager	123,380	116,399
	# Tweets	4,161	3,711
	# Twitter Impressions	6,025,000	10,091,000
	# Twitter Profile Visits	171,400.0	211,616.0
	# Twitter Mentions	1,058.0	704.0
	# New Twitter Followers	2,081	2,619
	# Courtesy Tows	39	26
	# Police Requests for TMC Camera Information Accommodated	55	90
	# Public Requests for TMC Camera Information Accommodated	16	24

[5] This was previously reporting the number of work orders approving signal timing changes. The metric has now been updated to show the number of individual intersections that received permanent timing changes.

INTRODUCTION

The 2019 Traffic Signals Annual Report provides an overview of the activities of the City of Winnipeg's Traffic Signals Branch including an introduction to the branch, key performance indicators (KPIs), and current projects.

Traffic Signals is responsible for designing, procuring, building, setting timing for, operating, and maintaining all electrified traffic displays within the city, including signalized intersections, flashing pedestrian corridors, keep-right flashers, and speed/prepare-to-stop signs. Traffic Signals also operates the Transportation Management Centre (TMC) – a real-time response unit that helps keep traffic moving and Winnipeggers informed of delays.

The report is divided into the following sections:

- ***Overview of Traffic Signals Branch***: Provides contextual information about Signals, including its role within the City of Winnipeg, branch-level objectives, and the main groups contained within the branch.

- ***Key Performance Indicators (KPIs)***: A selection of KPIs outlining performance in various areas, including infrastructure, operations, design, signal timing, and the Transportation Management Centre (TMC).

- ***Current / Ongoing Projects***: An overview of projects above and beyond day-to-day operational work.

OVERVIEW OF TRAFFIC SIGNALS BRANCH

The Traffic Signals Branch is responsible for the design, build, operation, and maintenance of all electrified traffic displays within the City of Winnipeg. This includes signalized intersections, flashing pedestrian corridors, keep right flashers, and speed / prepare-to-stop signs.

Traffic signals play an unusually large role in moving people and goods efficiently through Winnipeg due to the lack of freeways and the large number of railroad crossings.

Further adding to these challenges, the population of Winnipeg has grown steadily in recent years, from 637,200 in 2001 to 763,900 in 2019 (an increase of 19.9%).[6] A growing city means growing demands on the transportation infrastructure, with more traffic, more congestion, longer travel times, and increased frequency of collisions.

To meet these increasing demands on traffic signal infrastructure, Signals focuses on two main goals:

1. ***Safety***: Improving the safety of drivers and pedestrians on Winnipeg roadways.
2. ***Efficiency***: Fast and predictable movement or people and goods on Winnipeg roadways achieved at a low cost.

COMPONENTS OF SIGNALS

The Traffic Signals Branch consists of five main service areas: operations, design, procurement, timings, and the Transportation Management Centre (TMC).

Operations

The traffic signals operations team consists of electricians and technologists responsible for installing and maintaining all traffic signals infrastructure in the field. This includes two 24-hour on-call emergency response staff who respond to unexpected traffic signal malfunctions or damages. In 2019, operations were also responsible for contractor management, facility management, and yard maintenance.

Design

The design team is responsible for the design of signalized intersections. Activities include producing construction drawings, as-built drawings, and cost estimates for new signalized intersections, new pedestrian corridors, and upgrades/rehabilitation of existing traffic signals infrastructure. The design team is also responsible for managing installation of traffic signals underground infrastructure.

Procurement

Procurement is responsible for purchasing required materials to support the construction and maintenance of infrastructure, ensuring operations and other areas have the inventory required to perform their tasks, and ensuring all RFPs are completed.

Timings

The timings team consists of four timing engineers and one supervisor responsible for coordinating the timing of traffic signals. Traffic signal timing is done through proactive corridor reviews as well as in response to issues raised directly by citizens through 311. The timing engineers also provide support to the TMC by changing traffic signal timing in response to unusual congestion or traffic incidents. They also provide synchro analysis and internal engineering guidance to other branches on intersection functionality.

[6] https://winnipeg.ca/cao/pdfs/population.pdf

Transportation Management Centre (TMC)

The TMC serves a control center to monitor, manage and control daily road activity. It provides Signals with unprecedented ability to respond to incidents in real time, acting upon real-time data from cameras set up at 170 intersections (providing visibility to 573 km of regional roadway in the City), as well as data from 311 and Waze on roadway incidents and traffic jams.[7] The TMC is also conducts data management and coordinates with other stakeholders internal and external to the branch.

Figure 1 illustrates the organizational chart of the Traffic Signals Branch and its location within the broader Transportation Division within the Public Works Department.

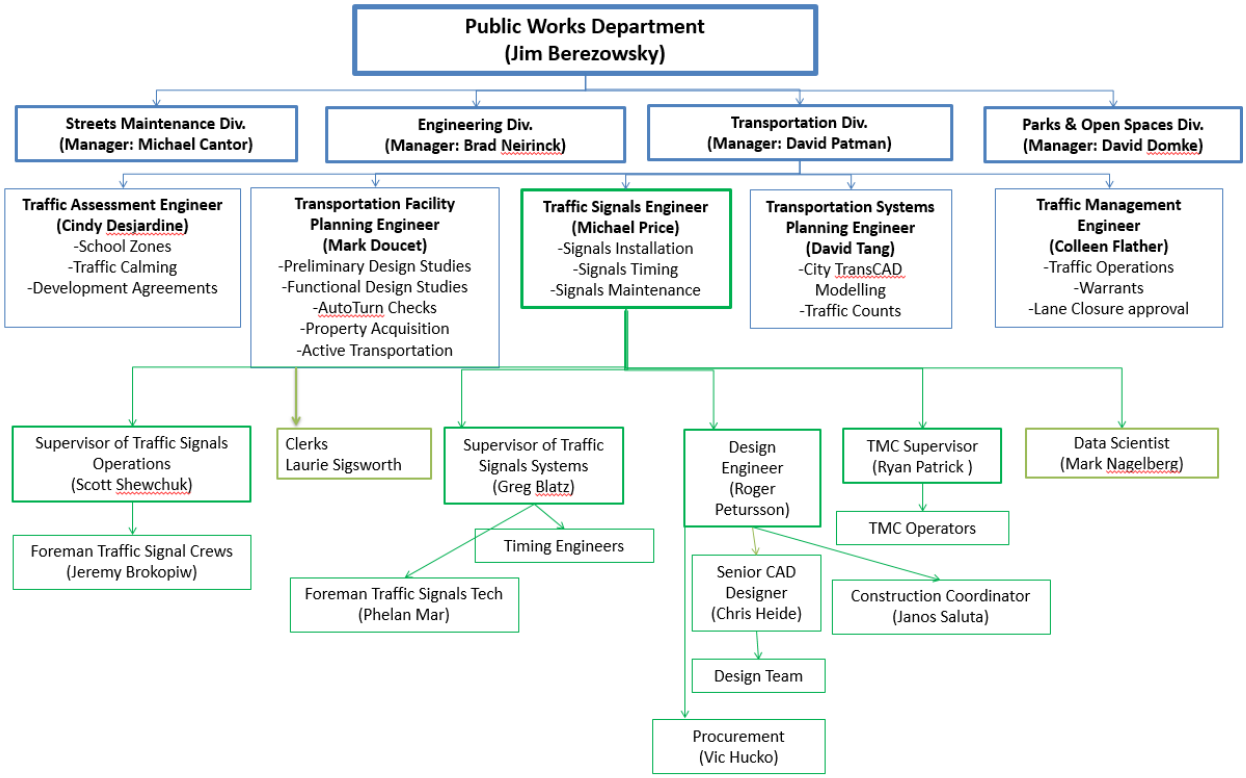

Figure 1: Traffic Signals Branch Organization Chart, current as of October December 2019
Traffic Signals branch positions marked with green

[7] Waze is a community-based GPS Navigation App owned by Google (https://www.waze.com/). The Traffic Signals Branch engaged in a partnership with Google and the Waze Connected Citizens Program, which enables the city to access anonymized data from Waze on road incidents and traffic Jams. The City of Winnipeg was the 2nd municipality in Canada to become a Waze partner.

KEY PERFORMANCE INDICATORS

Signals invests heavily in data for better situational awareness, more efficient processes, and the ability to report and monitor performance.[8] The incident data from the TMC is one example, but there are many other sources, such as traffic signals infrastructure (i.e. "Signals Inventory Database"), damages, malfunctions, travel time, TMC camera view areas, and more.

This section describes some of key performance indicators resulting from these data sources.

INFRASTRUCTURE, OPERATIONS, AND DESIGN

***Summary of Results**: The Traffic Signals Branch is responsible for 651 regular vehicle intersections, 18 half signal intersections, 7 flashing* red light intersections, *and 182 pedestrian corridors.[9] The number of these intersections and corridors has steadily increased over time. Similarly, the number of construction and as-built design drawings produced by Signals has increased substantially since 2014. Despite the increased workload, Signals was able to achieve a decrease in malfunctions from almost 6000 in 2010 to approximately 1200 in 2019 and has improved its ability to acquire recoveries for signal damages.*

KPIs within this group fall in the following categories:

- Number of intersections under management
- Traffic signal malfunctions
- Traffic signal damages
- Expenditures
- Work orders
- As-built and construction drawings

NUMBER OF INTERSECTIONS UNDER MANAGEMENT

As of early 2020, the branch manages a total of 651 regular vehicle intersections, 18 half signal intersections, 7 flashing red light intersections, and 182 pedestrian corridors. Figure 2 and Figure 3 illustrate the prevalence of signalized intersections in the City.

[8] Signal's ability to report on performance aligns with recent Audit recommendations to "develop and report on a comprehensive set of performance measures for each key area of the business".

[9] This does not include some infrastructure such as solar powered flash beacons (in medians and on stop signs), permanent count station locations, or "your speed" signs.

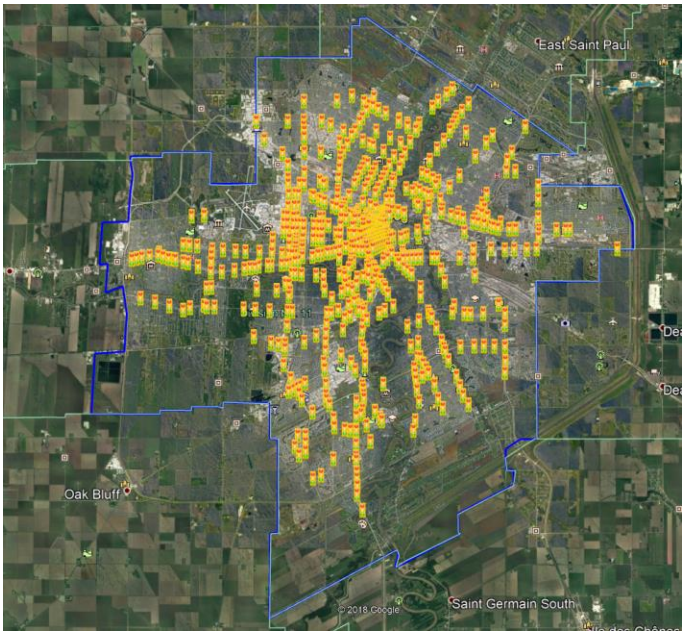

Figure 2: Active vehicle intersections in the City of Winnipeg, as of January 2019

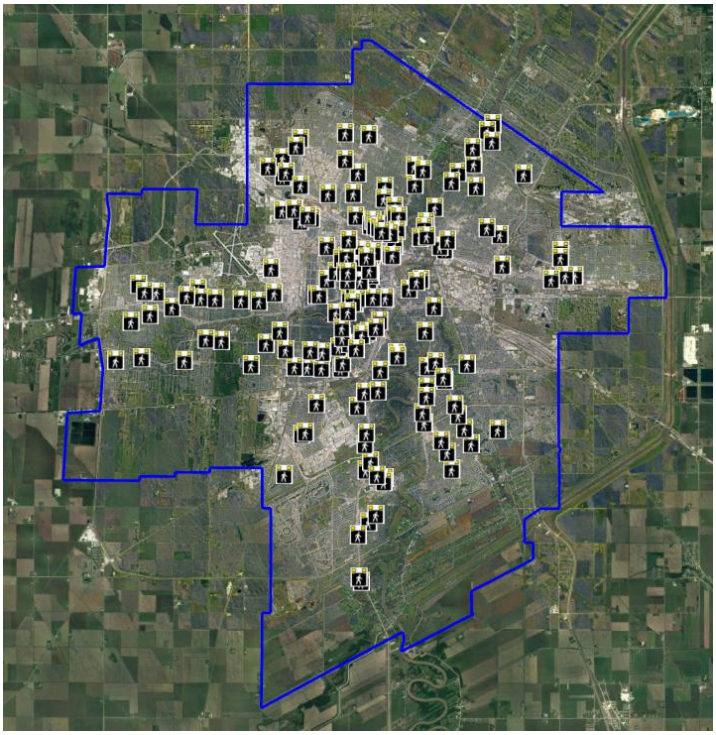

Figure 3: Active pedestrian corridors in the City of Winnipeg, as of January 2019

As illustrated in Figure 4 and Figure 5, both vehicle intersections and pedestrian corridors have steadily increased over time.[10]

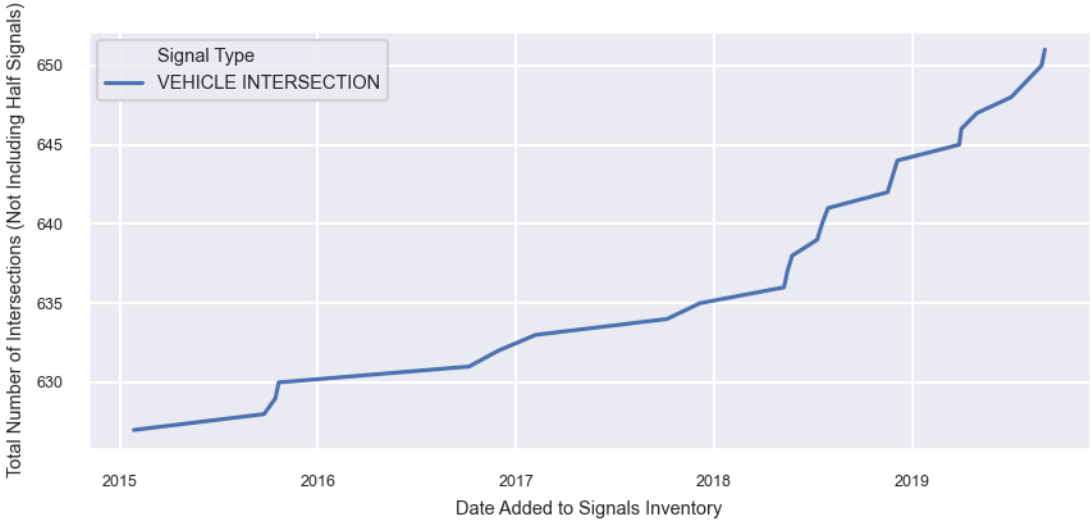

Figure 4: Number of vehicle intersections under management, from January 2015 to December 2019

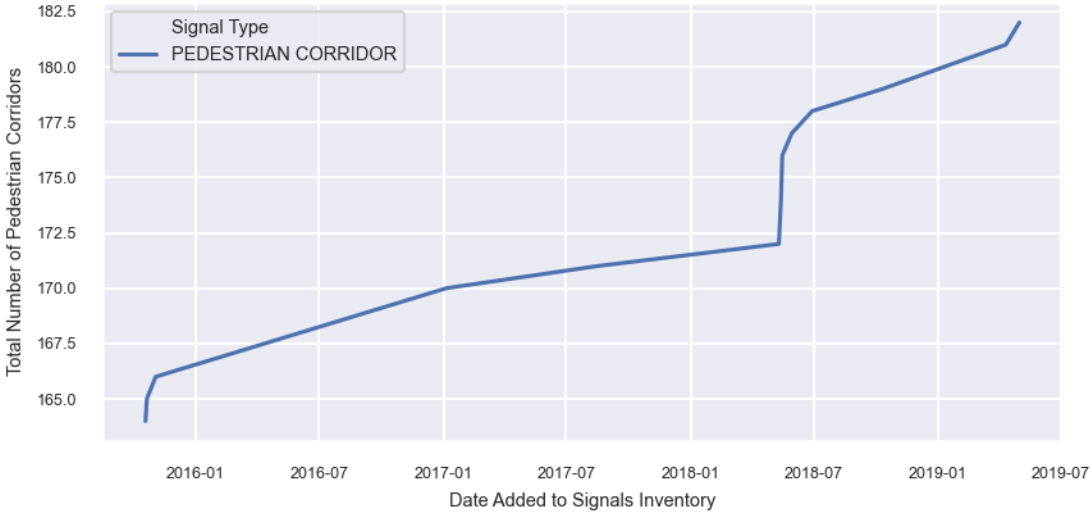

Figure 5: Number of pedestrian corridors under management, from October 2015 to December 2019

Accessibility of traffic signals infrastructure has increased as the branch works toward the goal of equipping every vehicle intersection in the city with accessible pedestrian signals (APS). As of the end of 2019, 95.4% of vehicle intersections have been equipped with APS. See Figure 6 for the trend over time.

[10] There is a delay between the time intersections are created and when the data is added to Signals Inventory. As a result, the charts may not contain some new intersections, and the dates intersections were added is a close approximation.

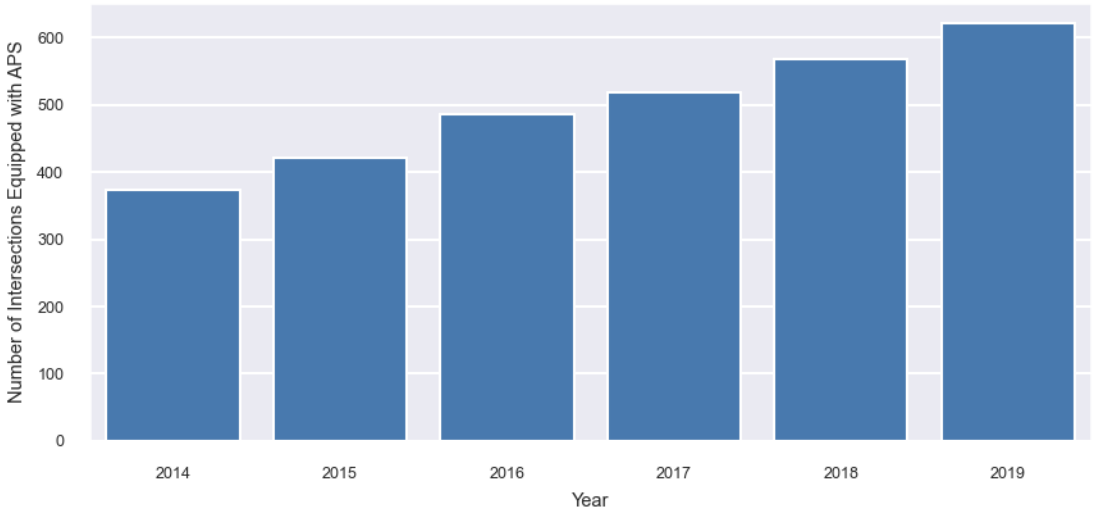

Figure 6: Number of intersections equipped with APS, from 2014-2019

TRAFFIC SIGNAL MALFUNCTIONS

Since 2010, the number of malfunction reports have decreased significantly. This reduces reactionary overtime, increases proactive maintenance, and increases resources available for maintenance of new equipment (e.g. cleaning/maintaining traffic monitoring cameras). See Figure 7.

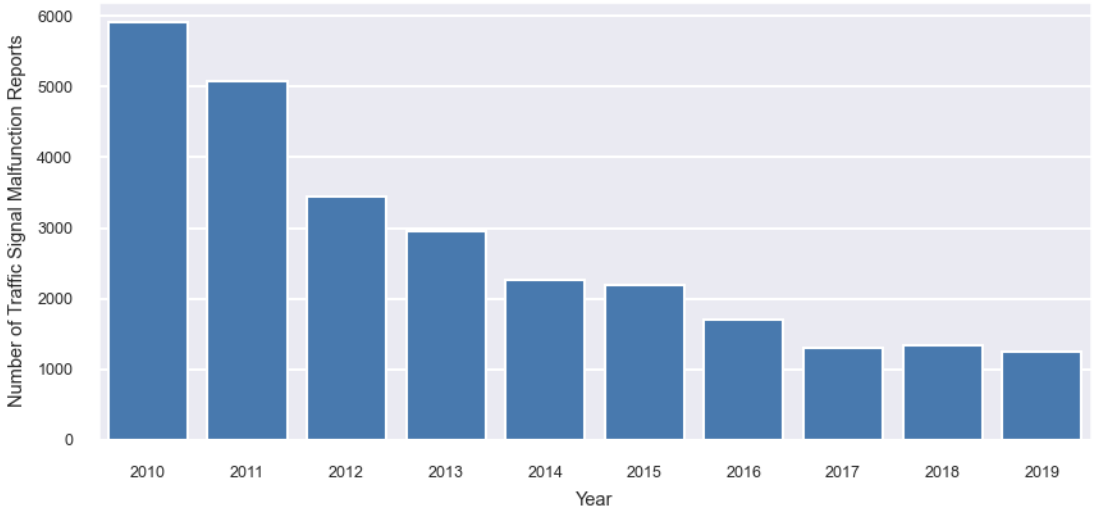

Figure 7: Number of traffic signals malfunctions, by year (2010-2019)

Figure 8 illustrates the trend in response times to malfunctions from 2010 to 2019 (an average of approximately five hours).

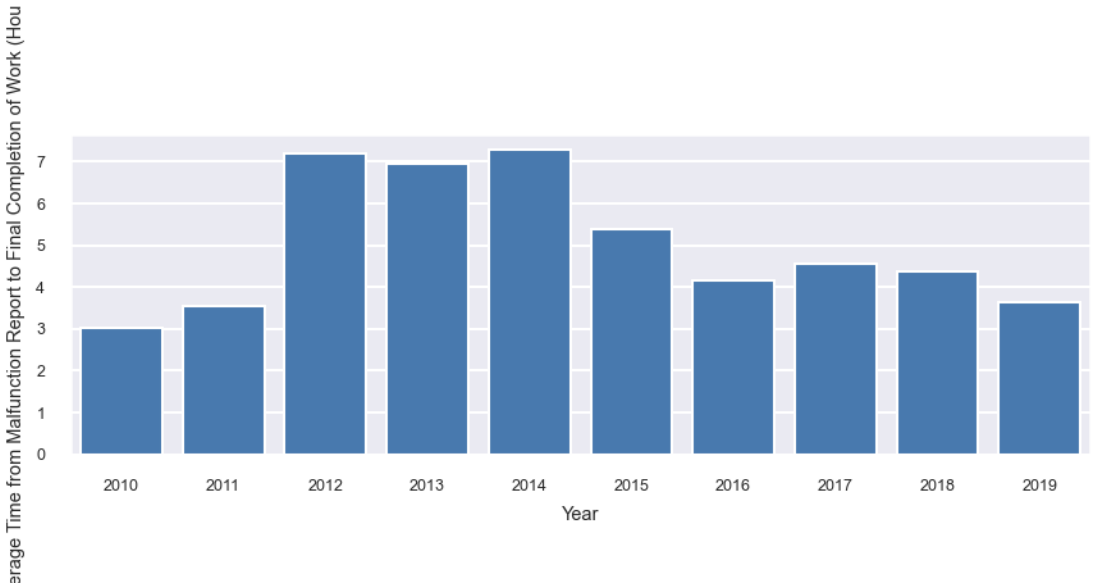

Figure 8: Overall average response times for traffic signal malfunctions, by year (2010-2019)

Overall response times can be divided into two subcategories: the time between when the malfunction is first reported and when crews arrive on site (Figure 9), and the time between when crews arrive on site and when the malfunction is resolved (Figure 10).

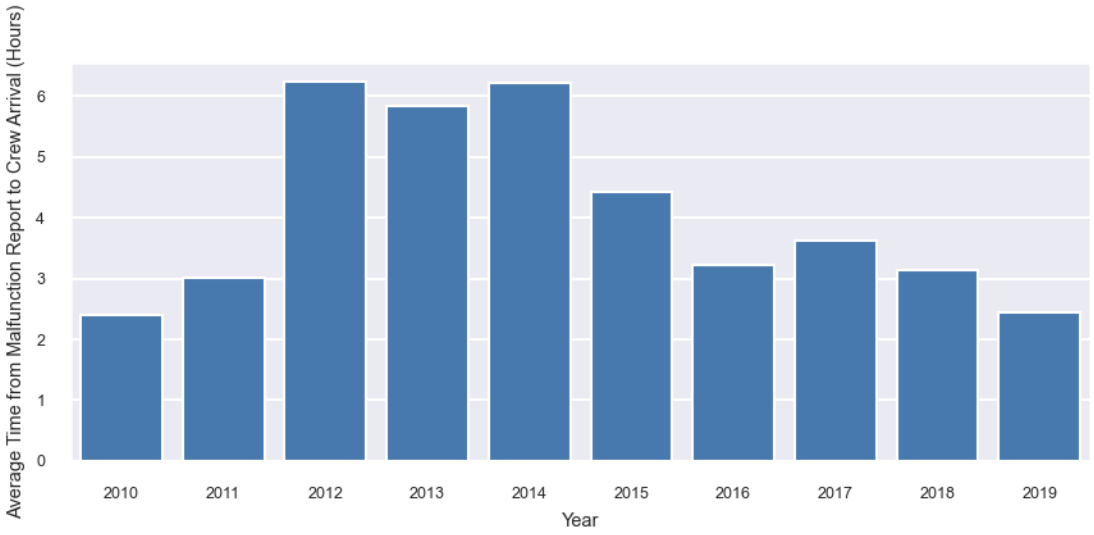

Figure 9: Average time from malfunction report to traffic signal emergency crew arrival, by year (2010-2019)

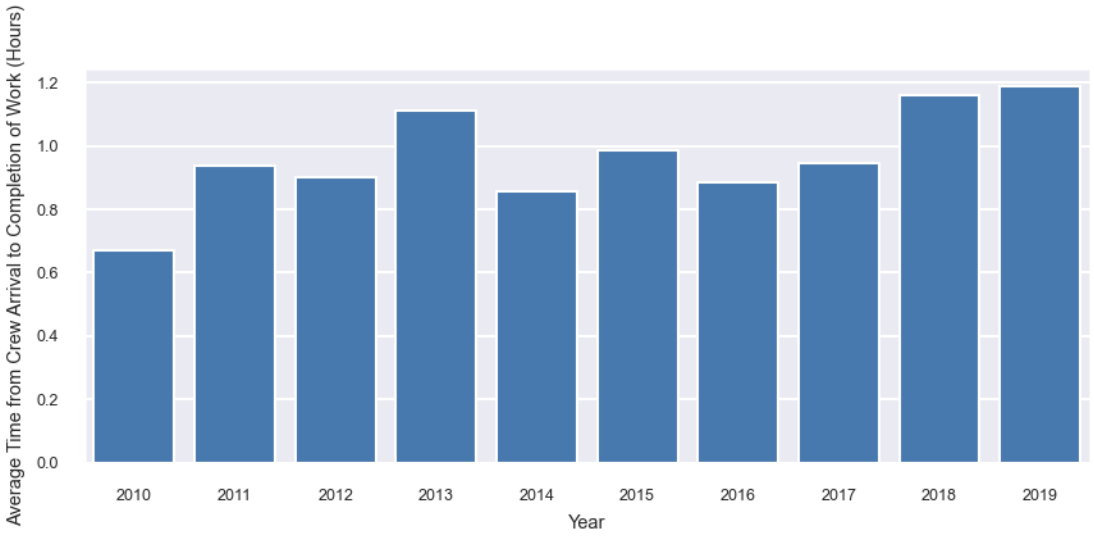

Figure 10: Average time from traffic signal emergency crew arrival to malfunction resolution, by year (2010-2019)

TRAFFIC SIGNAL DAMAGES

Since 2011, the number of damages has remained fairly consistent and averages 376.6 per year. See Figure 11.

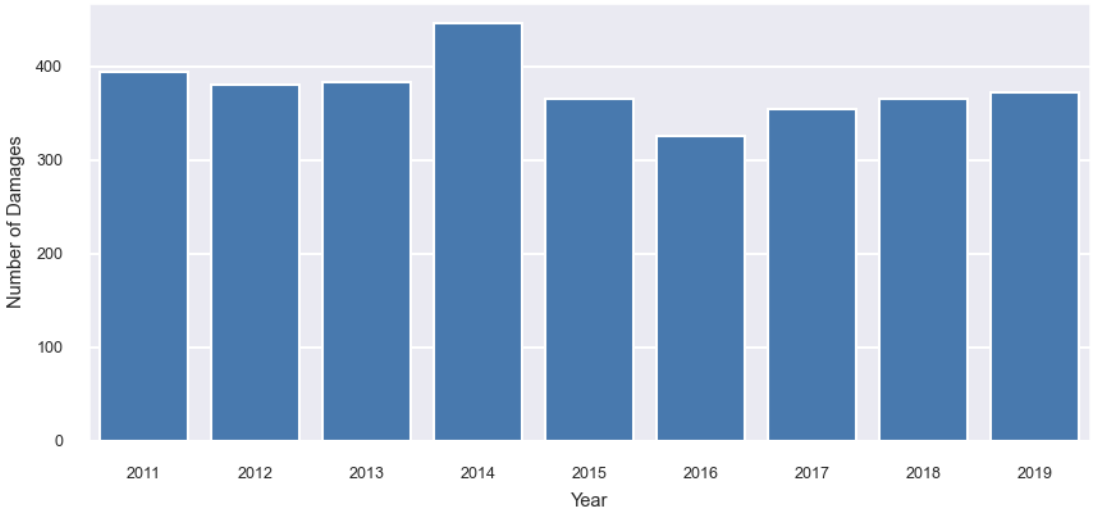

Figure 11: Number of traffic signal damages, by year (2011-2019)

Damages are most commonly caused by vehicle collisions. Signals has been increasingly successful at recovering these damages (i.e. recording a license plate, making it possible to make a Manitoba Public Insurance claim). Recoveries increased from 37.3% of damages in 2011 to 62.4% in 2019. Figure 12 and Figure 13 show the trend in recoverable damages and percentage of damages recoverable.

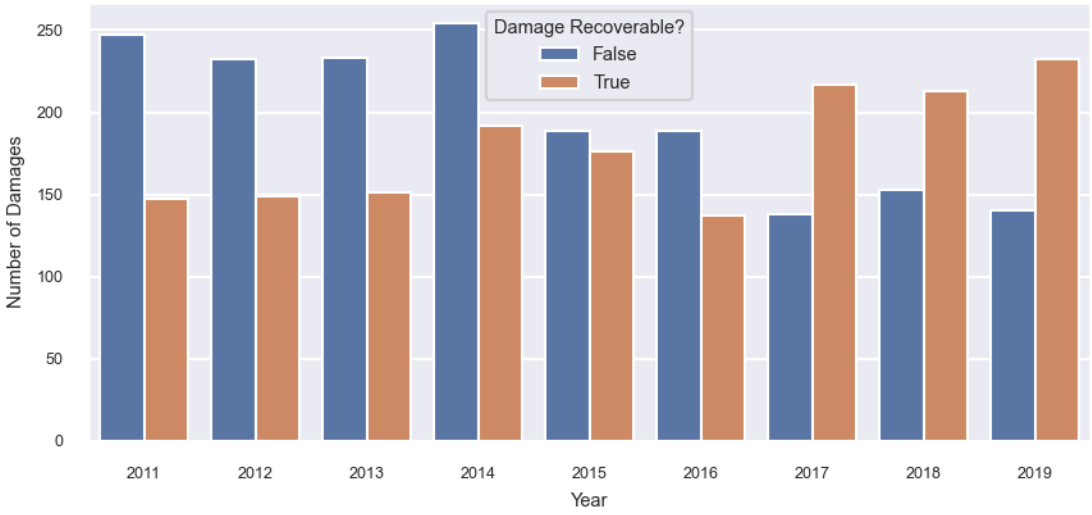

Figure 12: Number of recoverable and unrecoverable traffic signal damages, by year (2011-2019)

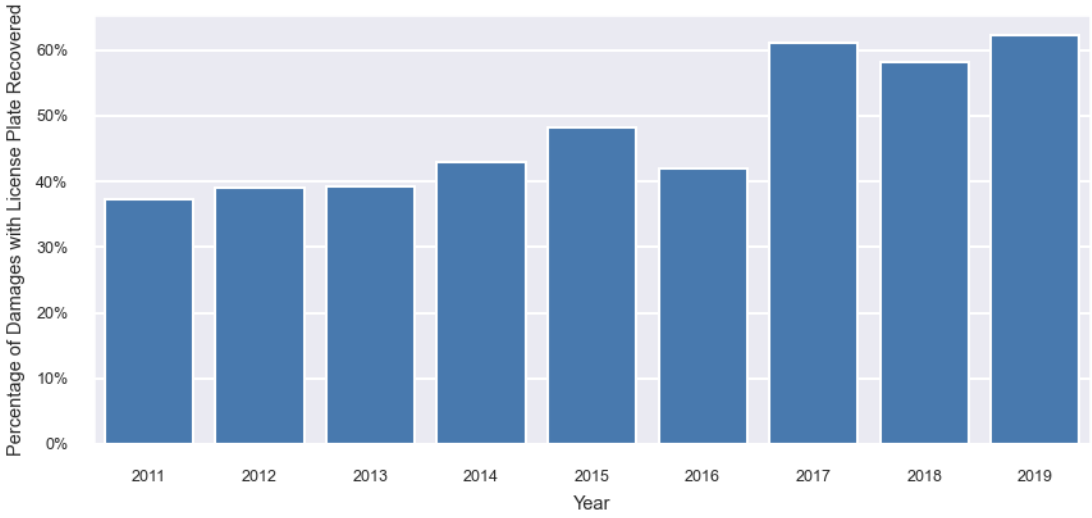

Figure 13: Percentage of traffic signal damages recoverable, by year (2011-2019)

EXPENDITURES

Expenditures fall into the following categories: underground contractor costs; purchases from Public Works Stores; and material and labour costs logged through an internal Materials Management System (MMS).

Traffic Signals Branch relies on external contractors to perform underground work associated with Traffic Signals: Black and MacDonald Ltd. and Harris Holdings Ltd. Overall, underground contract expenditures have increased substantially since 2017, from $1,856,349 in 2017 to $2,575,511 in 2018 (a 39% increase), to $2,836,030 in 2019 (a 9% increase).

As illustrated in Figure 14, the total expenditures recorded in MMS have remained between $4.5M and $6M from 2015-2019. From 2017 to 2018, the total expenditures reported here dropped almost $1.5M as a result of no longer tracking Public Works Department Stores materials expenditures in the internal traffic signals materials tracking system (these expenditures were already tracked in more detail in other systems). Figure 15 illustrates how these expenditures are subdivided into various categories.

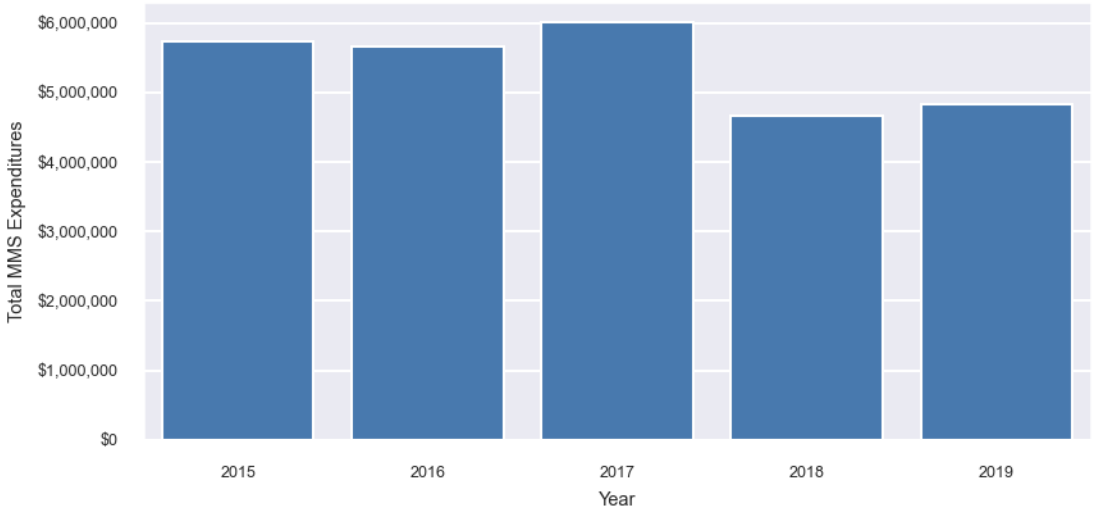

Figure 14: Value of MMS expenditures, by year (2015-2019)

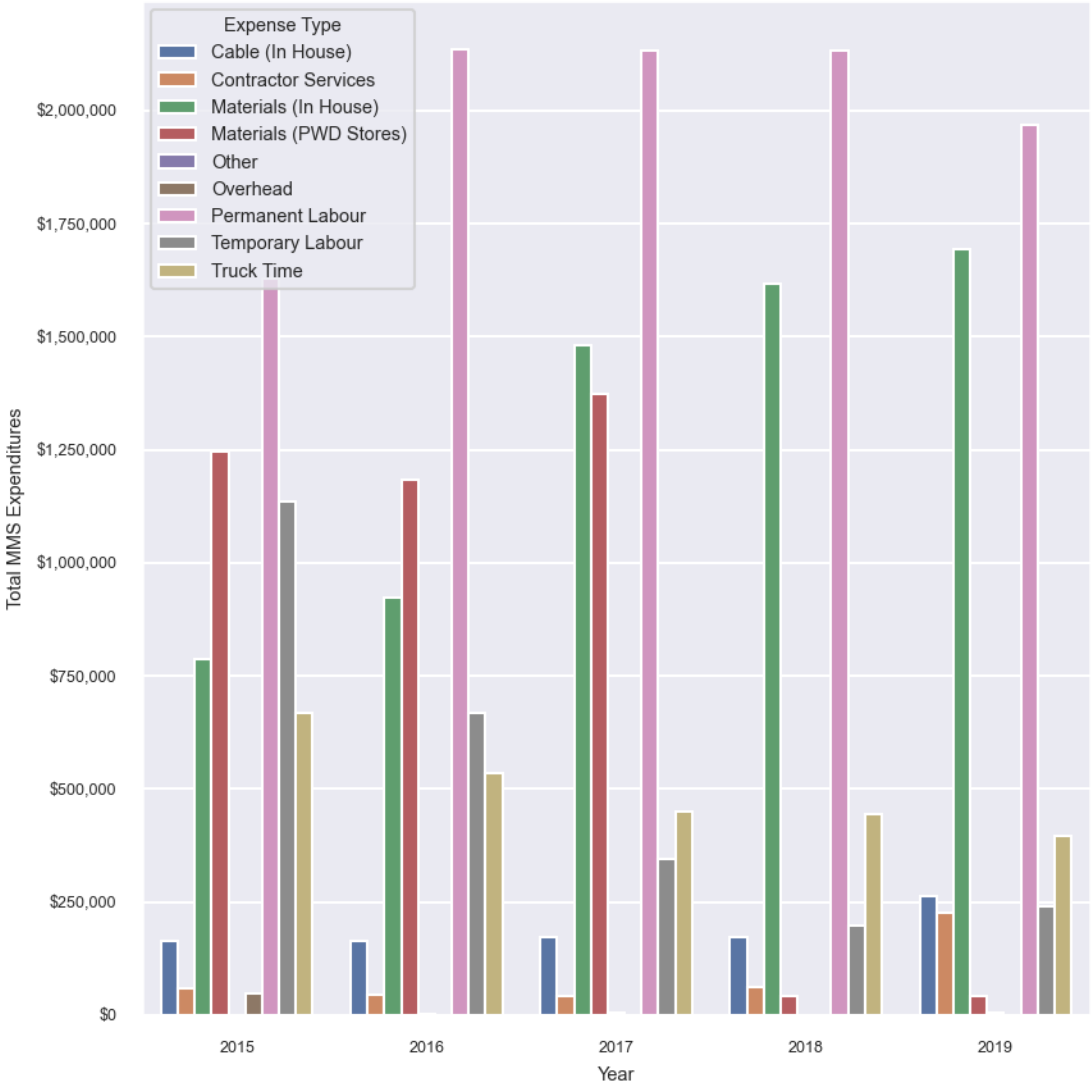

Figure 15: Value of MMS expenditures, by year and expense type (2010-2019)

WORK ORDERS

A fundamental unit of work for traffic signals operations is the work order, which represents a single identifiable job or task billed to an account. In 2019, Signals started 651 work orders, compared to 776 in 2018. The total number of work orders complete in 2018 was 351 while the number completed for 2019 was 512.

AS-BUILT AND CONSTRUCTION DRAWINGS

The Signals design group produces two main types of drawings for signalized intersections:

- ***Construction Drawing***: Illustrates the *planned* construction of the intersection
- ***As-Built Drawing***: Illustrates the *actual* construction of the intersection in the field

Figure 16 describes the total number of drawings created each year from 2014 to 2019; the total has increased over this period.

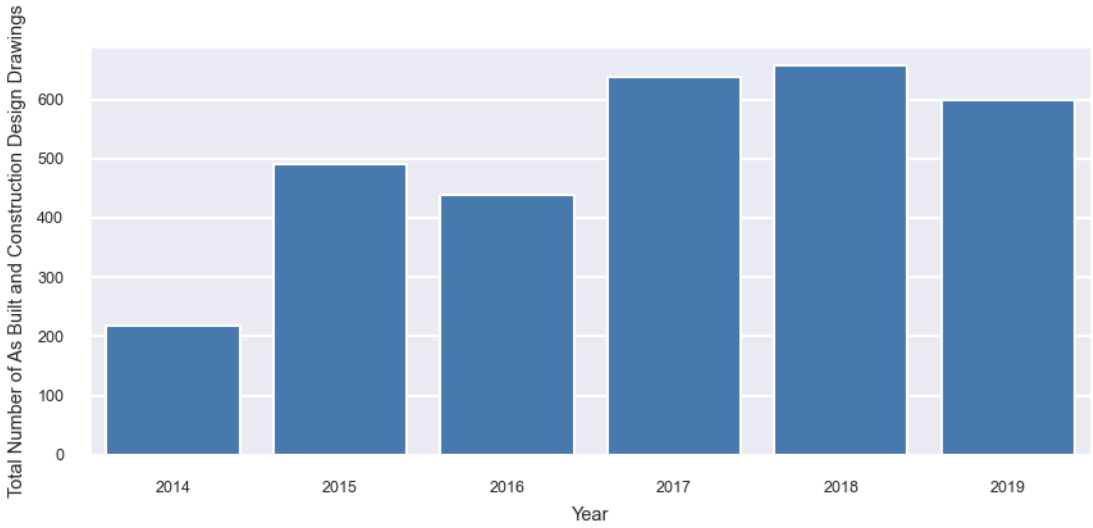

Figure 16: Number of design drawings, by year (2014-2019)

Figure 17 illustrates the number of each type of drawing over the same period.

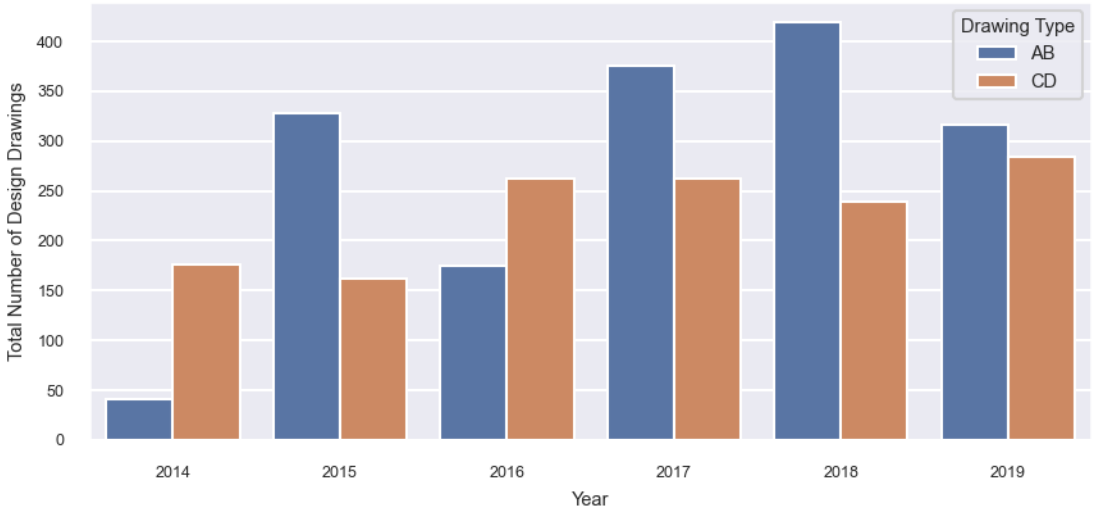

Figure 17: Number of construction and as-built design drawings, by year (2014-2019)

Every construction drawing must eventually have a corresponding as-built drawing create, as the actual construction in the field often differs slightly from the original construction drawing specifications. Therefore, an

important indicator for the design team is the number of outstanding construction drawings that do not have a corresponding as-built drawing, as they must eventually complete the as-built drawing. At the end of 2019, there were 229 of these outstanding drawings. Figure 18 shows the trend over time.

Figure 18: Number of intersections with updated construction drawings but no corresponding update to as-built drawings, by year (2014-2019)

SIGNAL TIMING

***Summary of Results**: From 2017-2019 AM travel times across 5 major routes have increased. Over 2016-2019, complaints to 311 regarding signals timing have declined 33.6% and the time to resolve these cases over this same period has declined 66.6%. Temporary timing changes have increased substantially from 2018 to 2019, from 1,247 temporary timing changes in 2018 to 1,831 changes in 2019. At the same time, the signals timing group is monitoring ongoing timing plans and making permanent timing changes accordingly (425 permanent timing change in 2019).*

TRAVEL TIMES

The most recent Winnipeg Community Trends and Performance Report describes average travel times overall across major routes from 2017 to 2019 (Henderson Highway, Main Street, Portage Avenue, and St. Mary's Road). [11] From 2017 to 2019, there have been increases in morning rush hour travel times along these routes.

[11] Report not yet published as of June 2020

AM PEAK HOUR AVERAGE TRAVEL TIME ON MAJOR ROUTES[12]	2017	2018	2019
HENDERSON HWY	12.0	13.0	15.3
MAIN ST	16.2	18.5	18.9
PEMBINA HWY	17.2	N/A (Pembina Underpass Construction)	22.5
PORTAGE AVE	21.6	20.1	23.7
ST MARY'S RD	19.9	18.4	21.1

More work needs to be done to isolate the impact of traffic signal timings on travel time, since other factors play a significant role, such as population size, number of registered vehicles, number of trips, weather, construction, special events, and roadway infrastructure changes (e.g. number of lanes).

TIMING COMPLAINTS AND CLEARANCE TIMES

As illustrated in Figure 19, the number of timings-related 311 cases dropped by 33.6%, from 545 complaints in 2016 to only 362 cases in 2019.

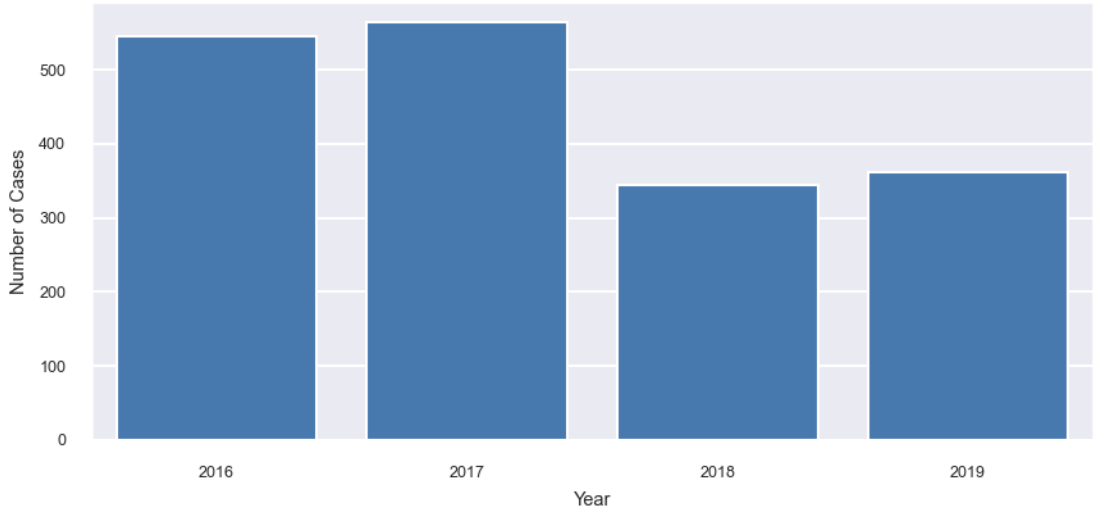

Figure 19: Total number of signal-timing related 311 concerns, by year (2016-2019)

[12] Starting 2019 travel time information is collected using City's WAZE data platform. Please see this link on City website for WAZE data description: https://winnipeg.ca/publicworks/transportation/TMC/Waze/whatisWaze.stm

In addition to the substantial drop in complaints to 311, the timing group is now addressing cases at significantly greater speeds. As illustrated in Figure 20, the average number of days required to resolve 311 signal timing cases decreased by 66.6%, from 160.1 days in 2016 to only 53.4 days in 2019.

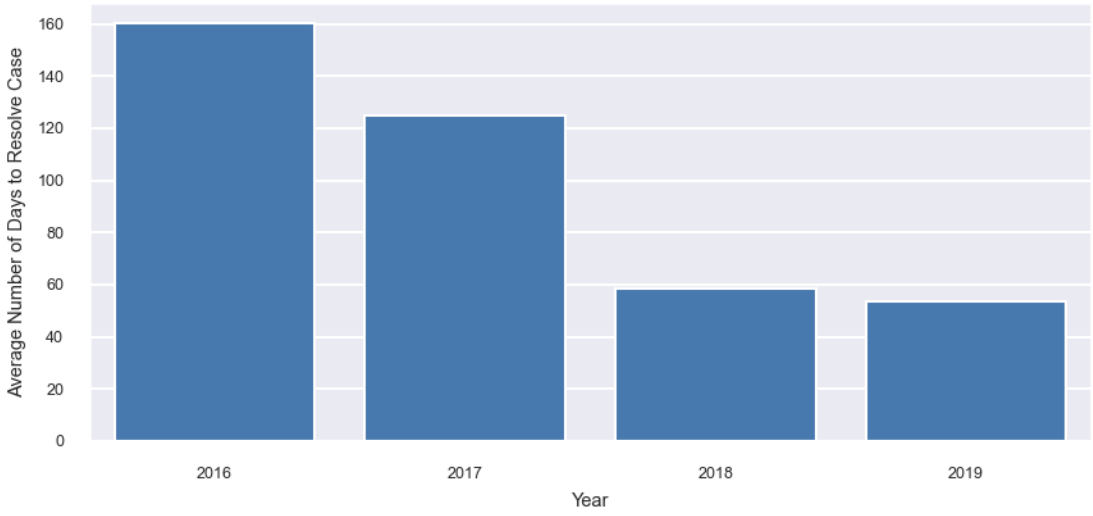

Figure 20: Average number of days required to resolve 311 concerns, by year (2016-2019)

TIMING CHANGES

Timing changes are divided into two main categories:

- ***Temporary timing changes***: These changes are either planned in advance (e.g. to accommodate construction, special events) or unplanned (changing timing to real-time road conditions and unexpected events, such as a stalled car).

- ***Permanent timing changes***: These changes are used on an ongoing basis, which may be the result of a detailed corridor review by timing engineers, or a change from temporary timing to permanent timing.

Temporary timing changes have increased substantially from 2018 to 2019, from 1,247 temporary timing changes in 2018 to 1,831 changes in 2019. See Figure 21.

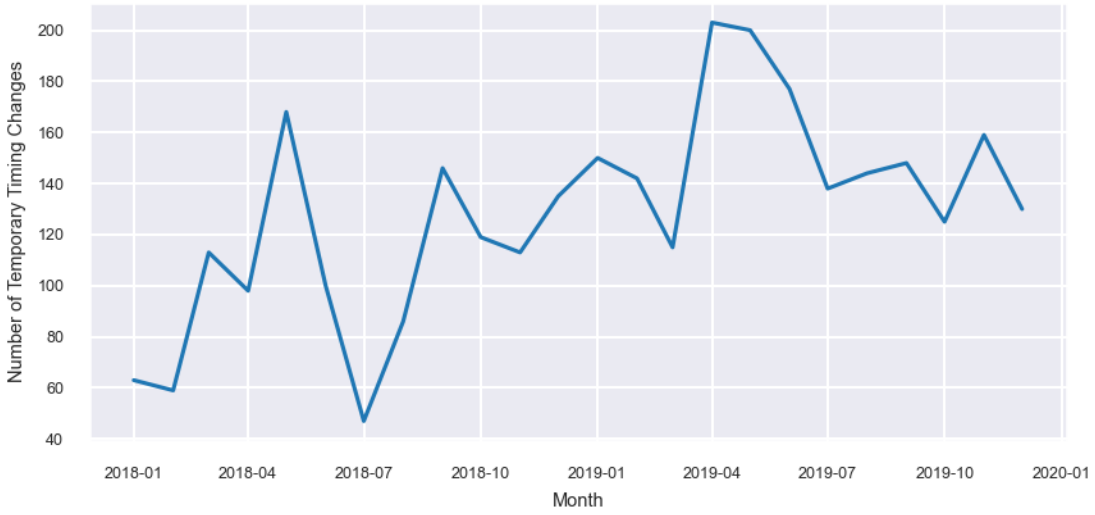

Figure 21: Number of temporary timing changes, by month (2018-2019)

Figure 22 shows temporary timings subdivided by type. Year over year, there have been substantial increases in the number of temporary timings within each type.

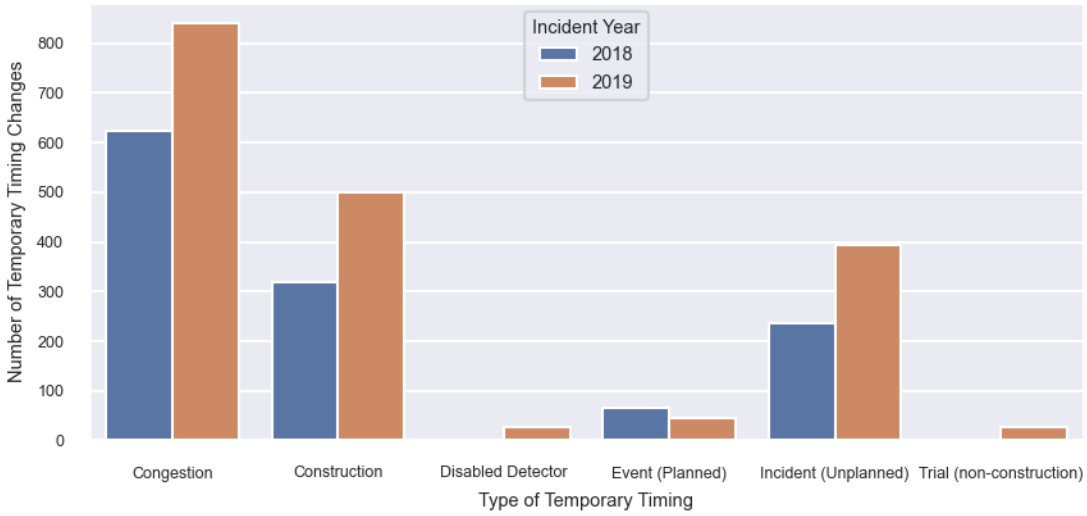

Figure 22: Number of temporary timing changes, by month (2018-2019)

Figure 23 shows the trend for each type by month.

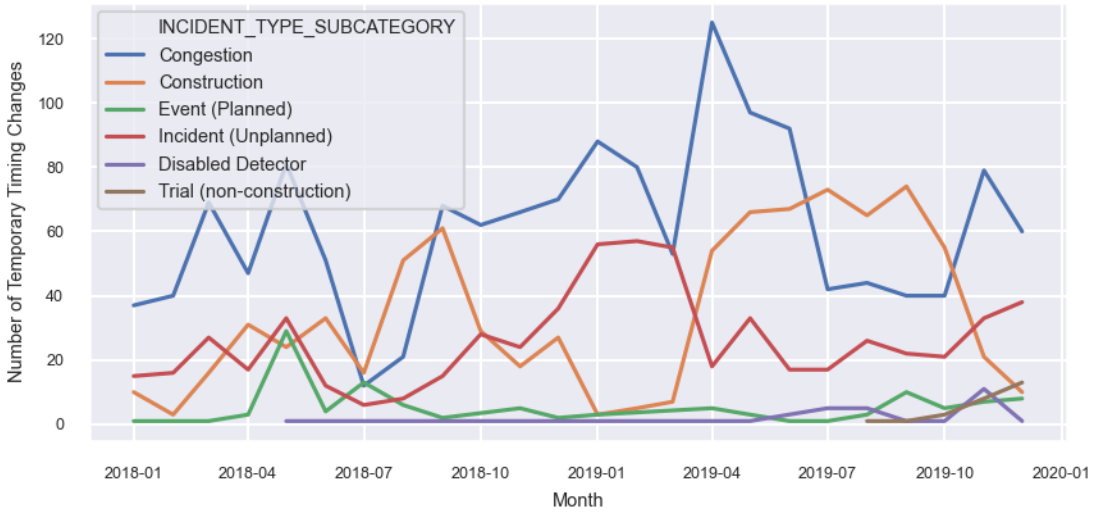

Figure 23: Number of temporary timing changes, by month and type (2018-2019)

Each temporary timing change contains information on the number of intersections receiving a timing plan change. As illustrated in Figure 24, most temporary timing changes affected a single intersection, although some timing changes affected up to 40 intersections.

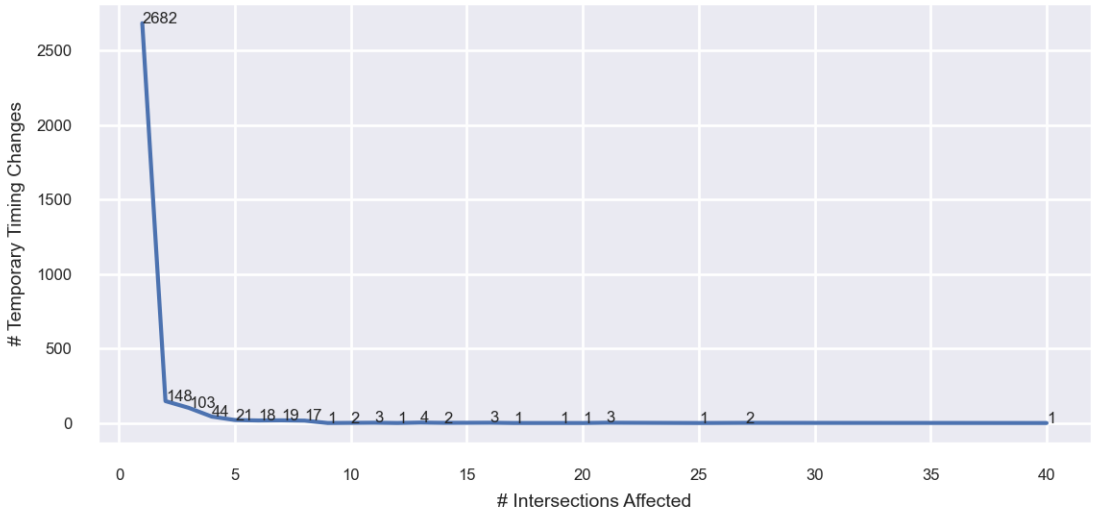

Figure 24: Number of intersections affected by temporary timing changes (2017-18)

Permanent timing changes have been tracked since 2018; there were 425 changes in 2019. Of these, 3 were the result of a corridor review and 50 were long-term temporary timing changes due to a temporary condition (e.g. multi-month construction lane reduction).

TMC

***Summary of Results**: The TMC has significantly increased its capabilities since inception. Operators can currently see 60.8% of the regional road network (which translates into approximately 573 lane kilometres). TMC operators monitor a data stream of over 115,000 incidents per year, and address them in various ways including temporary timings (described in the previous section), courtesy tows (26 of them in 2019), and tweeting information to the public (3,711 tweets in 2019).*

KPIs within the TMC fall in the following categories:

- Camera view area
- Incidents
- Twitter statistics
- Courtesy tows, Winnipeg Police Service investigations and FIPPA requests

CAMERA VIEW AREA

As of the end of 2019, 170 cameras were in operation providing visibility of 60.8% of the regional road network. This translates into approximately 573 lane-kilometres[13].

These figures have increased steadily since the launch of the TMC. Figure 25 shows the number of TMC cameras operational over time and Figure 26 shows the corresponding percentage of the regional road network covered.

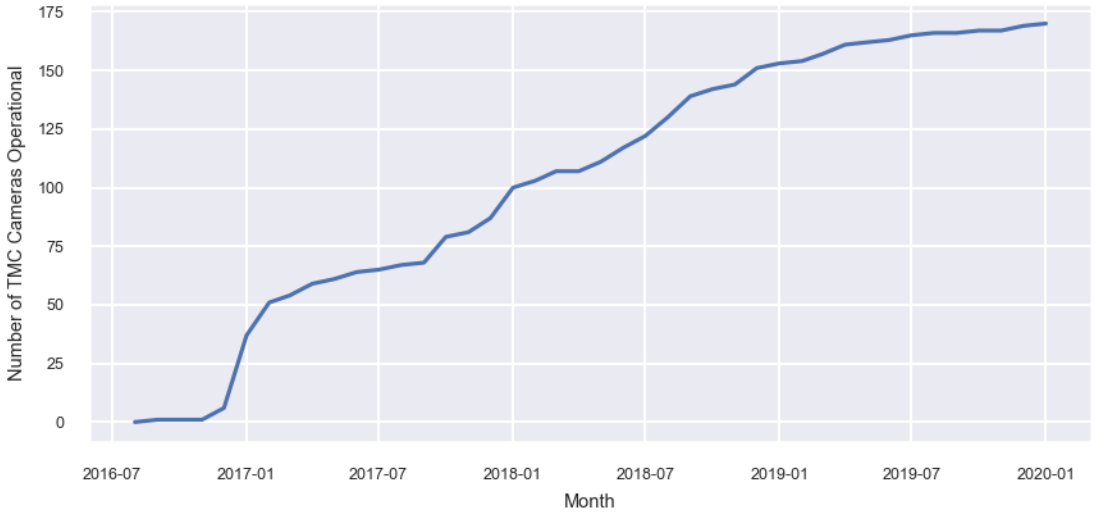

Figure 25: Number of cameras operational over time (2018-2019)

[13] This figure is calculated using City of Winnipeg map data that maps significant regional roads as dual-lines and moderate to small regional road as single line. As a result, the total visible area by lane-kilometres is higher than this figure, while the total visible area by centre-line measurement is lower.

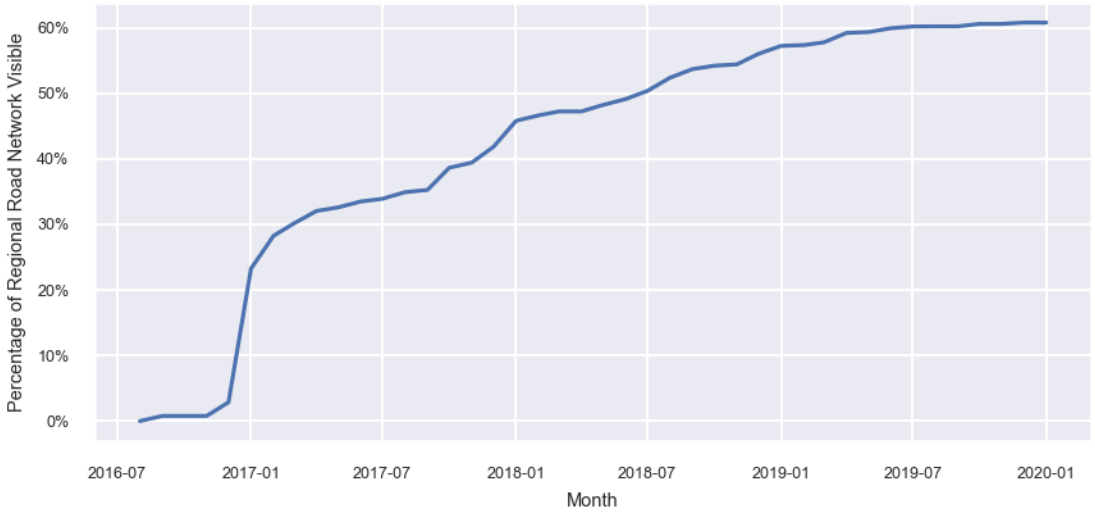

Figure 26: Percentage of regional road network visible to cameras over time (2018-2019)

INCIDENTS

The total number of incidents TMC operators received through the incident manager remained similar from 2018 to 2019, with 123,384 incidents in 2018 and 116,399 incidents in 2019. Figure 27 illustrates the monthly trend of the number of incidents over this period.

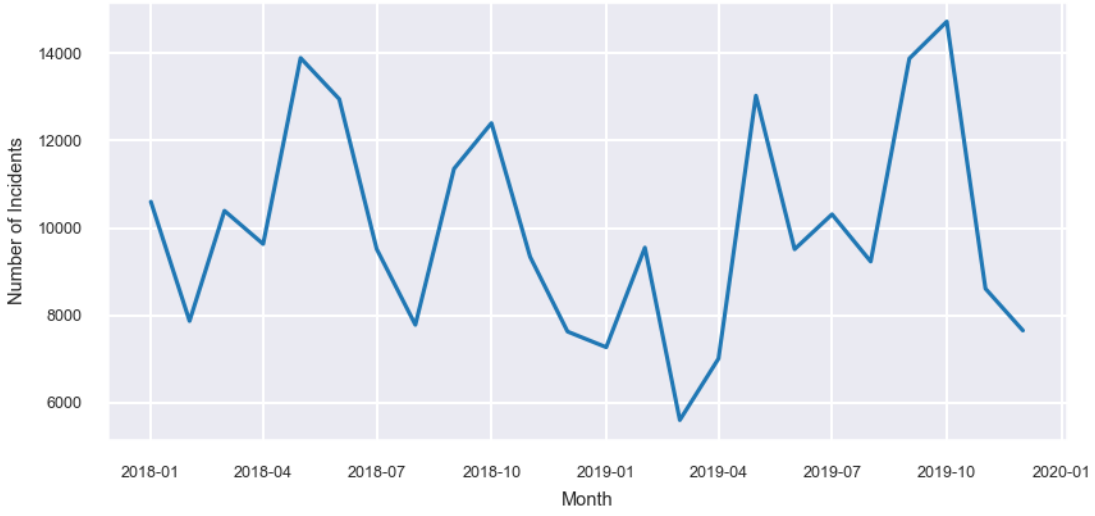

Figure 27: Total number of incidents reported in the Incident Manager (2018-2019)

As indicated by Figure 28, by far the most common source of incident data is Waze, followed by TRAINFO and 311. Figure 29 illustrates the monthly trend in the number of incidents for each of these categories.

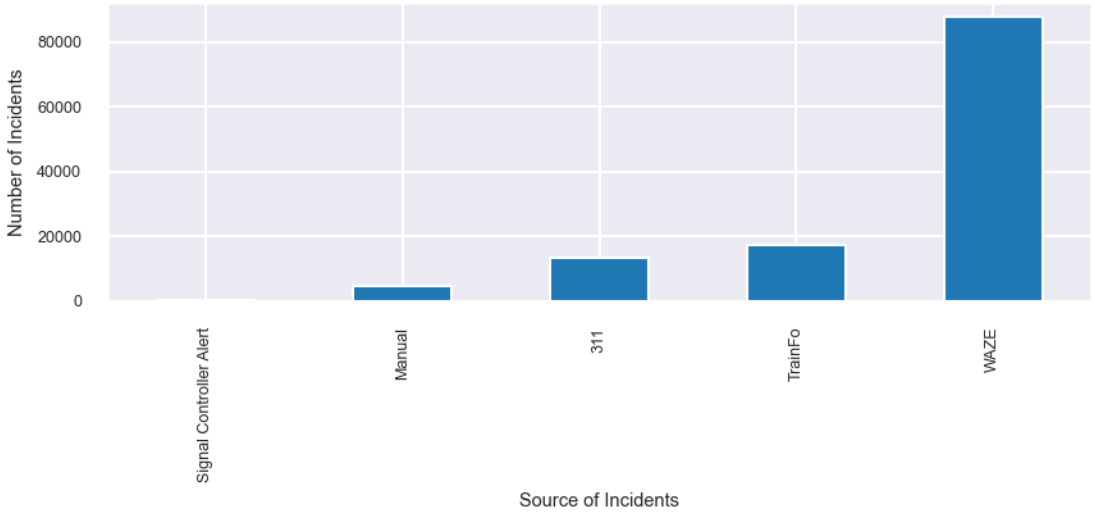

Figure 28: Total number of incidents reported in the Incident Manager, by type (2018-2019)

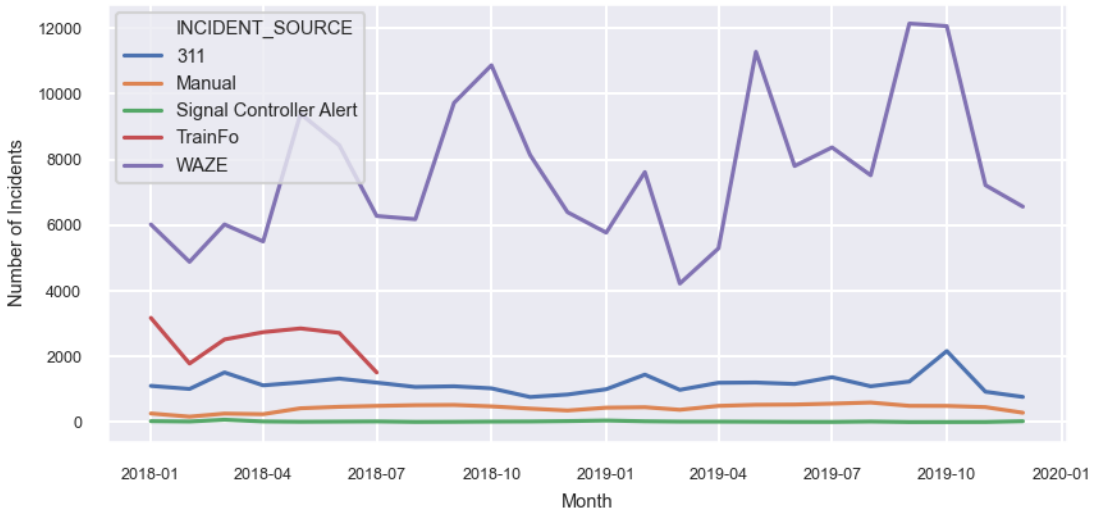

Figure 29: Monthly trend in total number of incidents reported in the Incident Manager, by type (2018-2019)

TWITTER STATISTICS

The TMC regularly provides real-time information to the public about incidents, primarily through the TMC Twitter feed, which began in September 2017:

- ***Number of Tweets***: The account tweeted 3,711 times in 2019.
- ***Number of Impressions***: The account had 10,091,000 impressions in 2019.

- ***Number of Profile Visits***: The account had 211,616.0 profile visits in 2019.

- ***Number of Mentions***: The account had 704.0 mentions in 2019.

COURTESY TOWS

One important service provided by the TMC is the "courtesy tow": when operators notice a stalled car blocking traffic in a major regional road, they will request a towing company to move the vehicle. The number of courtesy tow requests made by the TMC for 2018 and 2019 was 39 and 26, respectively.

POLICE / PUBLIC INFORMATION REQUESTS

The TMC receives requests for information related to the cameras from both the public and the Winnipeg Police Service. Table 1 and Table 2 describe the total number of requests and the number accommodated by the TMC. The total number of requests more than doubled from 2018 to 2019 for both police and public requests.

The most common reason for not accommodating a request is that the data is past the retention period (7 days). Other reasons include the camera pointing in the incorrect direction, vague or incomplete requests, or requests not meeting FIPPA (Freedom of Information and Protection of Privacy Act) requirements for release.

Table 1: Police Requests for TMC Camera Information, 2017-2019

Year	Total # Requests	# Requests Accommodated
2017	52	33
2018	121	55
2019	152	90

Table 2: Public Requests for TMC Camera Information , 2017-2019

Year	Total # Requests	# Requests Accommodated
2017	30	12
2018	67	16
2019	113	24

STATE OF THE INFRASTRUCTURE (SOIR)

Summary of Results*: The above-ground traffic signals infrastructure is in overall good condition. The total value of infrastructure is estimated at $39,659,648, of which only $1,508,538 is in poor condition.*

State of the Infrastructure Reporting (SOIR) provides an estimate of the replacement cost of above-ground infrastructure based on condition. The total estimated value of Traffic Signals Infrastructure is $39,659,648. By far, most of these costs are associated with pole and cabinet bases, followed by poles and arm, cabinets, and pedestrian, bike, and vehicle display heads. See Figure 30.

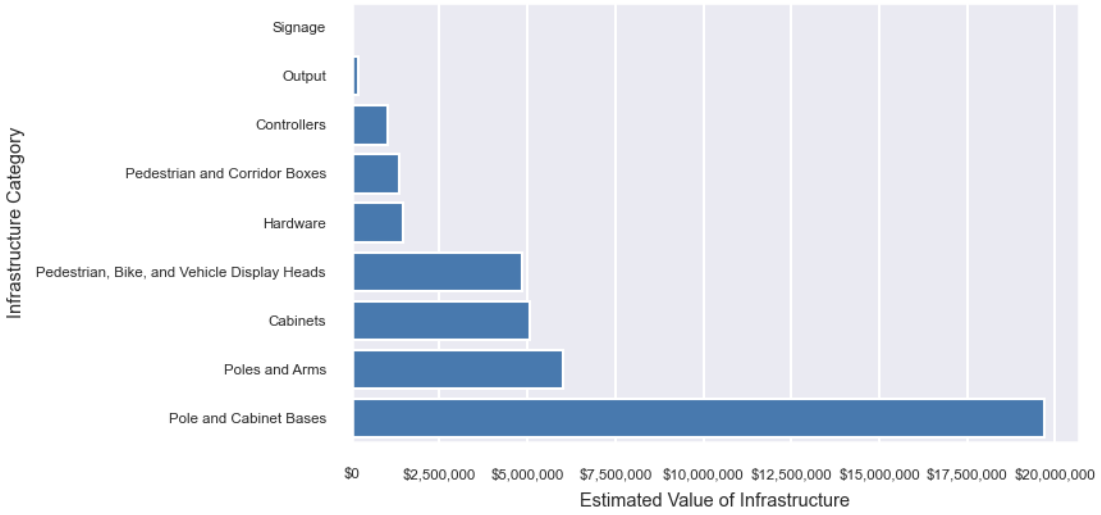

Figure 30: Total estimated value of infrastructure, by infrastructure type, 2019

Figure 31 provides more detail about condition within each of these categories. The vast majority of above-ground infrastructure is in fair to very good condition. Only about $1,508,538 worth of infrastructure is in poor or very poor condition, which translates into approximately 3.8% of the total value of traffic signal infrastructure.

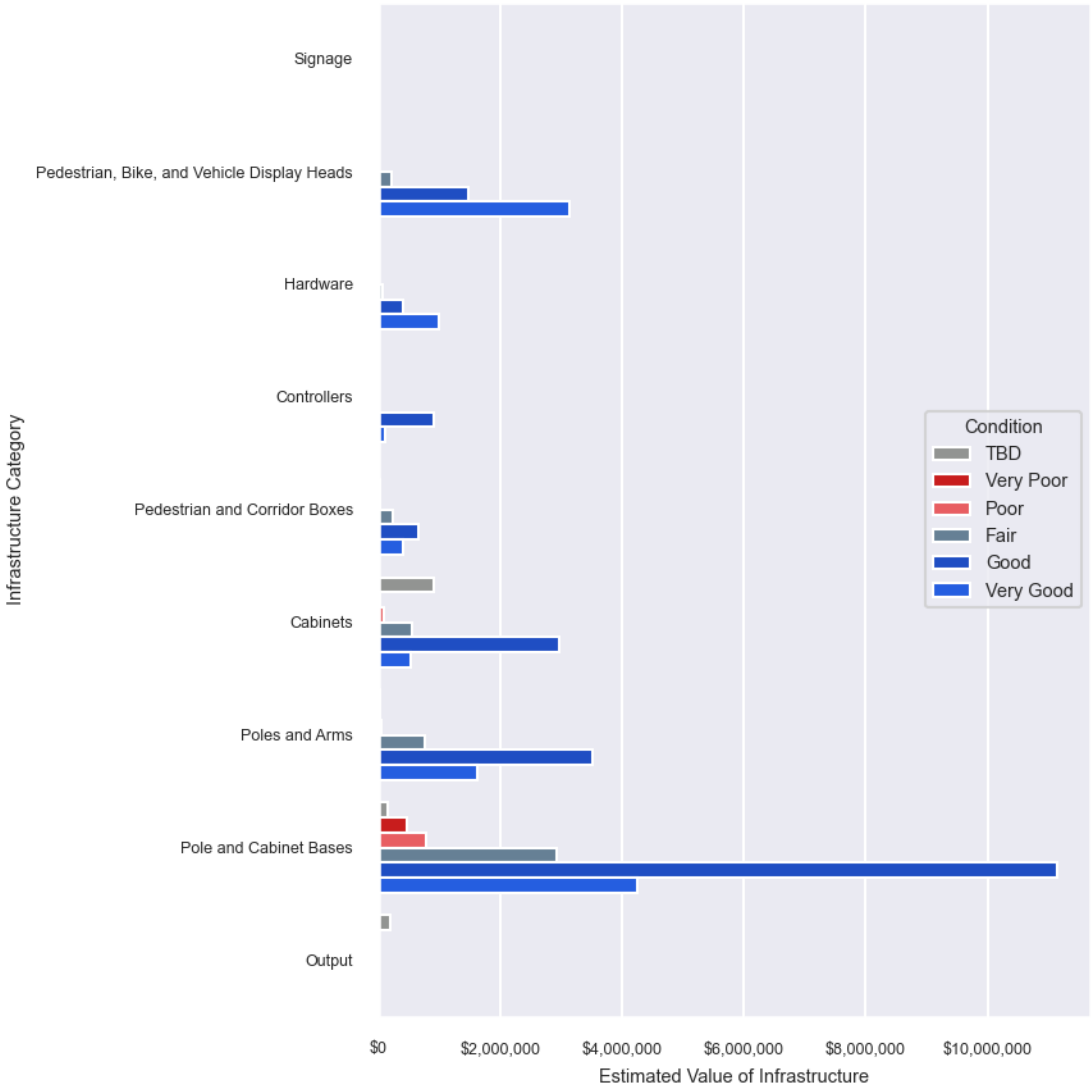

Figure 31: Total estimated value of infrastructure, by infrastructure type and condition, 2019

ONGOING ACTIVITIES

Signals engages in a wide variety of ongoing activities that support operations and facilitate achievement of our key performance indicators. These activities include:

- Data collection
- Data analysis, reporting, and automation
- Investigating and testing new signals technologies
- Improving traffic signals infrastructure
- Partnerships
- Process improvement

DATA COLLECTION

Data collected by Signals provides situational awareness that did not previously exist. This significantly affects efficiency as it allows for better planning, productivity, and allocation of resources. It also promotes safety by providing critical metrics about the condition of infrastructure and other intelligence to understand the significant risks to the public.

Signals is continually working on developing new data sources to fill gaps in situational awareness. These include:

- ***Traffic flow***: Traffic flow data helps our timing engineers understand where traffic is congested and where they need to make timing adjustments. Signals collects traffic jam data from Waze, and it previously collected data from the Google Maps API. However, these data sources don't provide information on traffic volume or origin-destination routes. Furthermore, the Google Maps API changed its pricing structure, resulting in a significantly higher price for the data after Signals contract expired in September 2019. As a result, Signals has incorporated the following new sources:
    - ***Permanent count stations***: Signals has installed 9 stations throughout the city in 2019 that provide ongoing vehicle counts.
    - ***Waze TrafficView Data***: Waze opened travel time data similar to the Google Maps API data. The data is free for Waze partners and allows monitoring a large number of routes across the city. In 2019, the Branch worked with PWD IS to develop a system to collect and store the data from the TrafficView API.

- ***Automated Vehicle Location (AVL)***: As we rely on fleets of vehicles to perform day to day operations, data about the location and state of these vehicles provides valuable input into operations. The Public Works Department has acquired AVL capabilities and is working to access and store the data in a usable format.

- ***Signals Inventory Updates***: The branch is continually adding new equipment to its infrastructure. This means that the Signals Inventory Database needs to be regularly updated and modified to reflect this new equipment. In 2019, the application was upgraded to include important information for asset tracking, such as component install date and other upgrades to improve flexibility of the program and the ability to add new equipment types.

- ***Internal operational data***: While the branch collects a significant amount of data on internal processes and operations, much of it is stored in inaccessible legacy or paper-based systems that cannot be queried or connected with other data. Signals is working to develop systems to digitize and store this information in proper databases that can inform Signals operations and improve process efficiency.

DATA ANALYSIS, REPORTING, AND AUTOMATION

Collecting data is not enough: it is crucial to also have systems in place to analyze and use the data in meaningful ways. Some specific activities in this area include:

- ***Power reporting***: Traffic Signals consume a large amount of power and Signals must report this usage regularly to Manitoba Hydro for billing. Previously, this was done using a manual and time-consuming process. Now, Signals collects power data on equipment and in 2019 has built a system that estimates power use in a fast, automatable, and repeatable way.

- ***Implementing reporting tools***: Data sitting in a database is not inherently useful. For it to be of value, staff needs ways to query and interact with it. Some specific efforts in this area include:

    - Implementing and promoting staff adoption of Business Intelligence (BI) tools such as Microsoft Power BI, which provide interactive reporting on data for staff in a usable format.
    - Developing a Traffic Signals Branch Report and corresponding key performance indicators.
    - Creating interactive dashboards reporting on a variety of information such as key performance indicators, comparing historical incident data to current trends, understanding infrastructure condition for maintenance prioritization, monitoring modem communication errors, prioritizing work based on planned construction, and more.

- ***Publishing Corridor Reports***: The timings group creates concise documents for corridor reviews that outline findings and possible improvements to timings. Each month a list of notable signal timing changes or completed projects are reported on the City website.

INVESTIGATING AND TESTING NEW SIGNALS TECHNOLOGIES

Technology related to traffic signals is constantly changing and improving, which means that the branch must stay informed and investigate the feasibility of implementing these technologies. Some examples of technologies currently under research include:

- ***Video Analytics***: The TMC camera infrastructure provides the possibility of implementing automated video analytics for a variety of applications. For example, this technology could be used to automatically count pedestrians or cars to understand traffic flow, or automatically detect collisions or other incidents that TMC operators should act upon.

- ***Low Amber Flashing Beacons***: Signals tested Low Amber Flashing beacons on pedestrian corridors, observing an increase in safety. As a result, these are now part of the standard pedestrian corridor designs.

- ***Rectangular Rapid Flashing Beacons (RRFBs)***: Lights designed to enhance safety of pedestrians by increasing visibility of activated pedestrian crossings. A trial for testing this technology is planned for 2020.

- ***Adaptive Signals Research***: "Adaptive Traffic Control" refers to traffic timing systems that automatically change in real-time based on actual traffic flow. The signals timing group is working on a literature review to understand whether and how other jurisdictions are implementing these systems.

IMPROVING TRAFFIC SIGNAL INFRASTRUCTURE

The branch is constantly working to improve safety and efficiency of its traffic signals infrastructure through revitalization and upgrade efforts. Some of the notable ongoing projects in this area include:

- ***Accessible Pedestrian Signals (APS)***: As part of an agreement with the Manitoba Human Rights Commission (MHRC), Signals has committed to equip all signalized intersections with APS speakers to aid those with impaired vision by 2023. These efforts are approximately 95.4% complete.

- ***Highway Head Replacement***: All signal heads with a 12" red, 8" amber, and 8" green indicator are in the process of being updated. For safety reasons, these are being replaced by heads with all 12" indicators, providing greater visibility. Only 46 of the old model remain.

- ***Reflective Heads***: Signals is working on providing all traffic signal heads with reflective tape to increase visibility and safety; 63.4% of all signals have been retrofitted to date. Figure 32 illustrates the trend in the number of reflective heads installed over time.

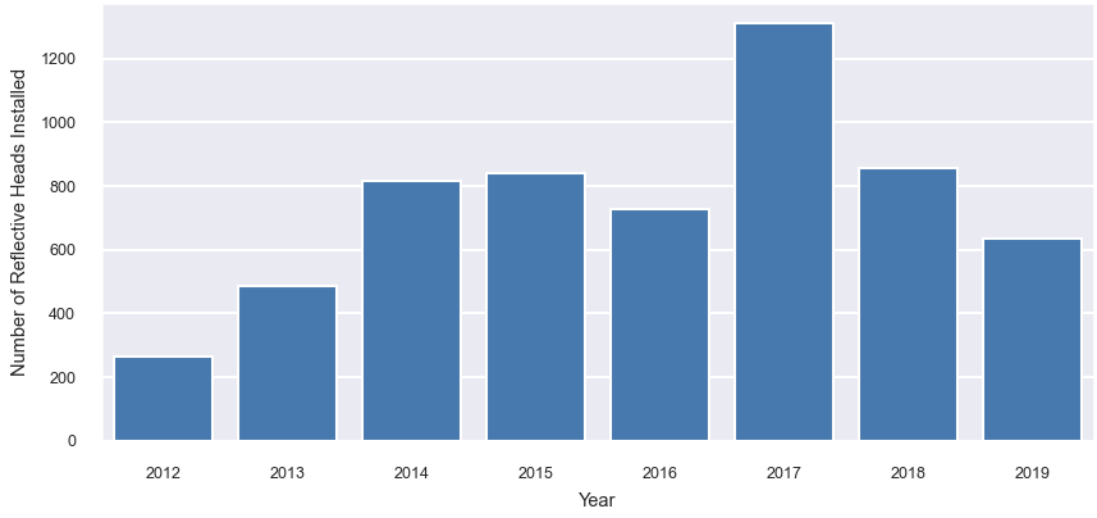

Figure 32: Number of reflective head purchases, by year (2012-2019)

- ***Controller replacement***: Traffic signal controllers are devices installed at each intersection that control the operation of the intersection. Signals is replacing older 170 style controllers with new advanced traffic controllers. The new controllers have many benefits including high-resolution logs which help the timing engineers make better informed decisions. They are also much more compatible with future connected vehicle technologies. The figure below illustrates the trend in the total number of new advanced controllers operational over time.

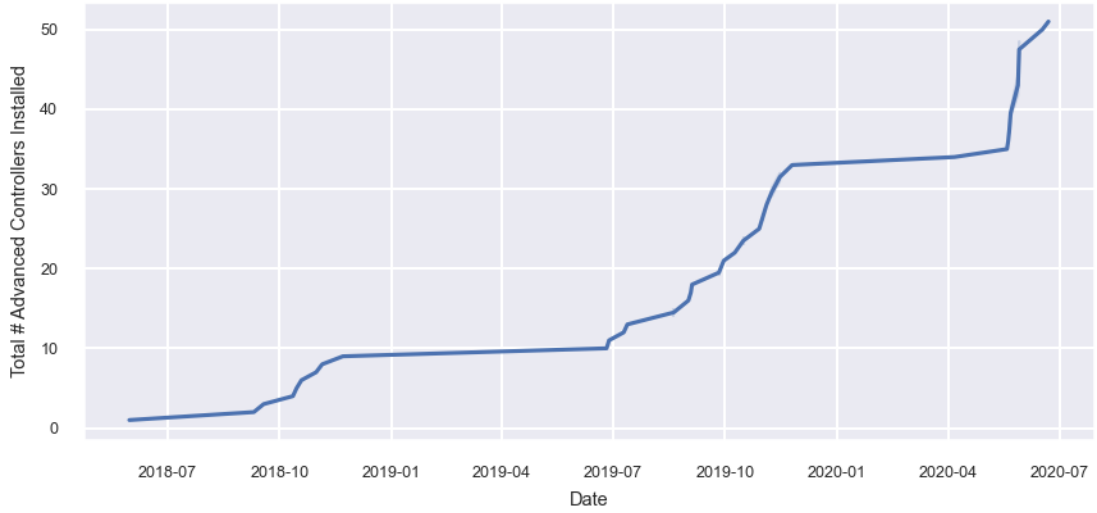

Figure 33: Total number of advanced controllers operational over time

- ***LED Conversion***: Signals is converting all traffic signals indications from incandescent bulbs to LED, significantly reducing power consumption.

- ***Preventative Maintenance Program***: In accordance with recommendations from a recent audit, Signals is creating and implementing a comprehensive preventative maintenance program for its infrastructure.

PARTNERSHIPS

Since the work of the Traffic Signals Branch is relevant to many stakeholders, there can be significant benefits partnering with stakeholders with shared interests. Signals cultivates partnerships with two broad categories of stakeholders:

- ***Interdepartmental Partnerships***: Notable projects in this area include working with Winnipeg Police Service to investigate opportunities to install downtown safety cameras, as well as efforts to promote training for emergency vehicle operators to promote efficient and safe lane closure procedures.

- ***University and Private Sector Partnerships***: Signals is in regular communication with university researchers specializing in traffic engineering and data analysis, examining opportunities for data sharing and mutually beneficial research. Furthermore, Signals is working with the private company TRAINFO to develop systems

that provide intelligence about train crossings in the city and how to mitigate traffic impacts. For example, TRAINFO and Traffic Signals Branch, along with university research partners, have jointly submitted a proposal for a project assessing the safety benefits of real-time railroad crossing blockage information system for emergency responders. The partnership with Waze is another example.

PROCESS IMPROVEMENT

Signals is constantly working to better improve the efficiency and effectiveness of internal processes. These efforts fall into two main categories:

- ***Documenting processes***: The first critical step to improving processes is fully understanding what the processes are and documenting them so they can be evaluated, improved, and repeated.

- ***Digitizing and automating workflow***: Signals has seen substantial increases in efficiencies by moving from paper-based to database-driven processes (for example, the decrease in malfunctions described in Figure 7). Signals continues to work to digitize paper-based processes and access data hidden in legacy systems.

CONCLUSION

The Traffic Signals Branch continues to operate at a high level, with low malfunction rates, quick response times, advanced signal timing capabilities, well-maintained infrastructure, and an unprecedented ability to see and address roadway incidents in real time. Signals achieves this through its highly skilled staff, along with investments in data and a wide variety of innovative projects. Signals plans to maintain this high operational performance while moving forward its innovative projects.