TORONTO

REPORT FOR ACTION

Automated Vehicle Pilot Deployment in Toronto Under the Highway Traffic Act

Date: April 24, 2025
To: Infrastructure and Environment Committee
From: General Manager, Transportation Services
Wards: Wards 4, 5, 9, 11, 12

SUMMARY

The Ministry of Transportation Ontario (MTO) has notified Magna International Inc. that their application into Ontario's Automated Vehicle Pilot Program has been approved, allowing Magna to conduct testing of automated last-mile delivery vehicles on Toronto's streets. This pilot is governed by Ontario Regulation 306/15 under the *Highway Traffic Act.* The City of Toronto has no regulatory authority over this pilot, however MTO invited City staff to review Magna's application materials and discuss details with their team. At MTO's request, City staff submitted comments to help inform MTO's decision-making regarding Magna's pilot license application. Staff comments did not offer an opinion on the capability of this vehicle's automated navigation but focused on operational-side measures to enhance safety and ensure the City's opportunity to learn from the pilot.

Magna's pilot will deploy driverless, three-wheeled automated vehicles to deliver small packages in an area including all of Ward 9 and portions of each of Wards 4, 5, 11 and 12. Each vehicle will have constant human oversight from a 'chase vehicle' with a supervisor capable of immediate intervention, as well as a remote human operator who can assume control during complex scenarios. Important safety measures include maximum speed of 32 km/h, travelling only on roads with a posted limit of 40km/h or less, no use of left turns, and adherence to internationally recognized cybersecurity and privacy standards. Magna's pilot will begin in Q2 2025 with a small number of vehicles operating on the city's streets; further MTO approval will be required prior to allowing more vehicles. Magna envisions up to 20 vehicles during this pilot.

Automated vehicle deployments for ridesharing, taxi services, deliveries, and long-haul trucking have steadily increased, predominantly in U.S. states such as California, Arizona, Florida and other locations that experience less snow and rain than Ontario. This Magna pilot represents an opportunity for the Province, the operator and the City to gain insights into automated vehicle technology and operations within Toronto's unique urban environment.

RECOMMENDATIONS

The General Manager, Transportation Services recommends that:

1. City Council direct the General Manager, Transportation Services to report back to Infrastructure and Environment Committee no later than Q4 of 2026 on the findings from Magna's pilot, and lessons learned for the City regarding operation of automated vehicles in Toronto and specifically their use for delivery of goods.

FINANCIAL IMPACT

None. There are no current or known future year financial impacts arising from the recommendations contained in this report.

The Chief Financial Officer and Treasurer has reviewed this report and agrees with the financial implications as identified in the Financial Impact Section.

DECISION HISTORY

Ontario Regulation 306/15 under the Ontario *Highway Traffic Act*: Pilot Project – Automated Vehicles
O. Reg. 306/15 PILOT PROJECT - AUTOMATED VEHICLES | ontario.ca

City Council on October 29 and 30, 2019 adopted the Automated Vehicles Tactical Plan as the framework for guiding future policy decisions related to automated vehicles in Toronto. The Guidelines for Submitting a Work Zone and Law Enforcement Interaction Plan to the City of Toronto were developed as an action item from this AV Tactical Plan and are an important input to the current proposal.
Agenda Item History - 2019.IE8.7

City Council on January 31, 2018 requested the General Manager, Transportation Services to undertake five specific actions including a detailed Automated Vehicle Tactical Plan, which together would help prepare the City for automated vehicles.
Agenda Item History - 2018.PW26.4

Executive Committee on September 22, 2016, Directed the General Manager, Transportation Services, to enter into a dialogue with the Government of Canada, the Government of Ontario, other municipalities, academic institutions and private sector groups within the City of Toronto to work towards the establishment of a multi-jurisdictional task force with a mandate to prepare for the introduction and extensive use of automated vehicles by private users, the public and private sector entities.

Agenda Item History - 2016.EX17.29

Public Works and Infrastructure Committee, at its meeting of May 16, 2016, requested the General Manager, Transportation Services, to report on how the City of Toronto might prepare for the introduction of automated and autonomous vehicles, including the following: a. Specific actions planned by Transportation Services to prepare for automated and autonomous vehicles over the next two years; b. An overview of potential implications that could be experienced by other divisions as a result of vehicle automation, and where possible, options for mitigating impacts; and c. An overview of the public's potential acceptance of automated and autonomous vehicles, and how it compares to other jurisdictions.
Agenda Item History - 2016.PW13.14

COMMENTS

The Ministry of Transportation Ontario (MTO) has notified Magna International Inc. that their application into Ontario's Automated Vehicle Pilot Program has been approved, allowing Magna to conduct testing of automated last-mile delivery vehicles on Toronto's streets. This Provincial pilot program is governed by Ontario Regulation 306/15 under the *Highway Traffic Act.* The pilot proponent is New Mobility Canada Delivery Systems Inc., an operating entity of Ontario-based Magna International (hereafter we simply use 'Magna' to refer to the pilot proponent.) Magna has developed a vehicle that operates with an Automated Driving System (ADS). This vehicle is fully driverless, operates on road, and offers services of last-mile delivery of food and other small consumer goods.

Magna's pilot has been approved by the Province and will be run by Magna; it is not a City of Toronto initiative and the City has no authority over its approval. Regulatory authority to approve this testing is fully within the jurisdiction of the Ministry of Transportation. This Magna pilot, conducted under approval from the MTO, will take place on Toronto's streets beginning in Q2 2025. The Ministry of Transportation invited City of Toronto staff to review all application materials submitted and encouraged staff to discuss the application details directly with Magna. MTO requested input from the City to ensure that the municipal perspective is included as part of their internal review but made no commitments regarding if or how the City's comments will influence conditions that may be placed on approval of the application.

This report to the Infrastructure and Environment Committee will provide Council with an understanding of what they can expect to see on Toronto's streets once Magna begins operations, and for staff to share observations within the scope of their expertise. Communications plans are in development by both Transportation Services and Magna to inform the public of what to expect.

Highway Traffic Act: Pilot Program - Automated Vehicles

Ontario Regulation 306/15 under the *Highway Traffic Act* provides for a 10-year period of testing automated vehicles in the Province, starting in 2016. A 2019 amendment provided the option to operate without a human driver or attendant on board. Companies wishing to pilot automated vehicles on any public roads in Ontario must apply to the MTO for a license to operate; each application is reviewed separately by the Province and licenses are issued with very specific operating parameters.

Any vehicle approved for a license under O.Reg 306/15 must comply with Canada's Federal *Motor Vehicle Safety Act* or receive an exemption for importation. This Federal legislation sets and enforces compliance with safety standards for manufactured and imported vehicles and equipment and allows for the evaluation and testing of automated vehicles manufactured in Canada or imported from elsewhere. Transport Canada has also released guidelines for the testing of automated vehicles and encourages provinces to consult with them when reviewing applicant safety information.

O.Reg 306/15 does not provide for municipal approval or engagement, and does not allow municipalities to opt-out of the program or of any specific deployment. However, current application materials include the following two conditions for driverless vehicles:

(1) that municipalities be provided with a Work Zone and Law Enforcement Interaction Plan, and
(2) that municipalities be notified in writing that testing will take place.

The Work Zone and Law Enforcement Interaction Plan must explain how the vehicle will interact with any emergency vehicles, how the vehicle will react to construction zones and how it will interact with police and construction personnel on public roads. The MTO requires annual reporting from participants, but these reports are not shared with municipalities.

Since its launch in 2016, the program has had 14 approved participants, including passenger vehicles (e.g. cars), low speed shuttle services and light duty commercial vehicles.

The following is a partial list of Ontario Automated Vehicle pilots, based exclusively on information shared through participant websites or in the media.

WATonoBus:
Waterloo All-Weather Autonomous Shuttle Bus operates autonomously on the University of Waterloo campus. A remote operator observes from a nearby lab to take over driving functions if needed. This AV trial began in 2021, providing a complementary shuttle service on a 2.7km route around the campus' Ring Road. It has four designated stops and can carry up to 10 passengers.

The Whitby Autonomous Vehicle Electric (WAVE) Shuttle (2021):WAVE provided service with a slow-moving, 10 passenger shuttle connecting the Whitby GO Station to neighbouring communities. The automated vehicle had a human safety attendant who was able to stop and take control of driving when required. This trial ended when the shuttle was involved in a single vehicle collision when it was operating in manual mode and the automated hazard mitigation systems were not engaged.

City of Toronto's West Rouge Automated Shuttle Trial:
This automated shuttle had a human safety attendant who was able to stop and take control of driving when required. It underwent two months of validation and testing in late 2021 on a four kilometre route between the West Rouge community and the Rouge Hill GO Station. Due to factors outside the control of the City and its project partners, the trial was ended prior to service being offered to the public.

Gatik driverless grocery delivery, Peel Region:
Middle mile logistics company Gatik launched a driverless grocery delivery truck in partnership with Loblaws. Between January 2020 and October 2022, Loblaw and Gatik transported more than 150,000 autonomous deliveries, always with a safety driver on board.

These trials provided important lessons to the MTO and local municipalities about the state of automated vehicle technology, the capabilities and weaknesses of the technology, and what information to look for when a new application is submitted.

The Current Pilot Participant: New Mobility Canada Delivery Systems Inc. (an operating entity of Magna International)

New Mobility Canada Delivery Systems Inc. is an operating entity of Magna International, a global mobility technology company headquartered in Aurora, Ontario. Magna has over 170,000 employees across 28 countries and is the world's third-largest automotive parts supplier. Magna has a facility located within their proposed service area, in which they will store their fleet of delivery vehicles, maintain remote operators who can take control of the vehicles when needed, and where they hope to move their manufacturing capabilities for these vehicles.

Since 2018, Magna has invested in developing a customized on-road autonomous delivery vehicle. The vehicle proposed for deployment in Toronto is the second generation of the design, developed following testing and validation activities of five first-generation vehicles. Magna's development process for its automated driving system (ADS) has included trials in closed-environment test areas designed to mimic urban environments and testing in a range of public, mixed-use traffic environments in and around Detroit, Michigan, and in Europe, including at Magna facilities. The vehicle also underwent durability testing in Ohio, tests in a wind tunnel and engineered rain facility at Ontario Tech University in Oshawa, and cold weather testing in Michigan.

Magna's LMDD and ADS successfully completed a delivery services pilot on public roads near Detroit, Michigan from 2022 to 2023 without a safety incident.

The Magna Automated Last Mile Delivery Device

Magna's Last Mile Delivery Device (LMDD) is a three-wheeled vehicle approximately the size of a large cargo bike, and the height of a typical sedan automobile. A photo of the LMDD can be found in Attachment 1. It can operate autonomously using Magna's ADS technology and is not designed to carry a human operator or passenger. Magna's vehicles have been lawfully imported under a Temporary Vehicle Importation System (TVIS) permit which, under the Canadian Motor Vehicle Safety Act, allows each vehicle to be used in Canada for up to 1 year.

The LMDD has space to carry small packages stored in separate locked compartments which are each secured with a multi-digit code only known to the receiving customer. The LMDD travels no faster than 32km/h and Magna will operate it only on roads with a speed limit of 40km/h or less. When making a delivery, the LMDD parks in an available curbside space and customers must walk to the vehicle to retrieve their deliveries. During this pilot, the LMDD will always be followed by a conventional vehicle with both a human driver and a passenger whose role is to supervise the automated LMDD – known as the "chase vehicle". This supervisor can instigate an emergency stop of the LMDD and can control it at very low speed to move it to the side of the road; they can otherwise intervene to maintain the safety of other road users around the LMDD. The chase vehicle will park near the LMDD while the end customer retrieves their delivery, and resume following once delivery is completed. The LMDD will also be supported by a remote operator, located in Toronto, who can fully control the LMDD via a secure, dedicated teleoperation driving station. An active voice link is maintained between the remote supervisor and the safety supervisor in the chase vehicle.

Magna has requested a permit to deploy up to 20 LMDD vehicles during the pilot, beginning with only 1-2 LMDDs and expanding over time. MTO approval will be required each time Magna seeks to increase the number of deployed vehicles. Each LMDD will receive its own Ontario license plate and will be subject to the same road rules as conventionally operated vehicles, except for the exemptions provided to permit driverless testing within the pilot program regulation.

Attachment 3 contains Magna's further description of the LMDD and how it works.

Summary of Vehicle Specifications:

Dimensions: 1.8m (L) x 1.1 m (W) x 1.35 m (H)

This height is slightly lower than a mass market automobile such as a new Honda Civic, but about 2/3 of the width and just under half the length.

Maximum speed: 32 km/h.

Control: Operates autonomously using a combination of 360 Degree Cameras, radars, and LiDar system. Radar and LiDAR work by emitting radio wave (radar)

and laser (lidar) pulses and measuring the time they take to reflect back, allowing calculation of shape of an object and its distance away.

Signage: In accordance with MTO requirements, signs will be positioned on the exterior of the vehicle to alert other road users that it is automated with no human driver. The LMDD will be further identified by a flashing light on top, which is visible from up to 30m away. A QR code on the side of the vehicle will link to further information on the company's website.

Proposed Deployment Area and Proposed Deployment Phasing

The proposed area for deployment is shown on the map in Attachment 2. It is bounded on the north by Eglinton Ave, on the east by Avenue Road, on the south College St (east of Dufferin Ave) and Queen St (west of Dufferin Ave), and on the west, Parkside Drive and Keele St, with an additional area bordered by Dundas and St Clair as far as Jane St. Magna will not operate on the roads which define the borders of this area (other than St. Clair and Dundas, around the Stockyards Mall area) because the vehicle is designed to operate in speed limit areas of 40km/h and below.

Magna indicates they have selected Toronto instead of other Ontario locations because of the high number of roads with posted speed limits at or below 40km/h, particularly roads of that speed which have commercial businesses and provide a suitable density of delivery origins and destinations to make a viable operation.

Phase One of Magna's deployment will begin by focusing on the south-west quadrant of their proposed service area. Once the initial deployment has proven successful, they will expand to deploying more vehicles and eventually hope to use the full proposed service area.

Cybersecurity and Privacy

Cybersecurity refers to the protection of systems, networks, and data from digital threats or unauthorized access. Careful attention to cybersecurity measures helps protect privacy of data and the security of the vehicle. Magna follows recognized industry cybersecurity standards and has established policies and procedures for protection of data and systems, and incident response plans which would be followed in the event of any suspected cyber-attack. Software updates are secure, and vehicles are always monitored electronically for immediate detection of a cyber-attack.

Magna limits the collection of personal information to only what is required and will collect and store data from the ADS Sensors (Camera, RADAR, LIDAR, Microphone for Sirens). This data is used to train its ADS algorithms that perceive surroundings and determine safe motion of the vehicle. Vehicle license plates will be automatically blurred but faces of pedestrians will not because Magna believes that pedestrian faces are very useful to determine gaze, pose and intent of motion of a pedestrian or cyclist, such as whether a person is about to cross the path of a vehicle or not.

The City will obtain only high-level operational statistics of the LMDD. The City will not require or receive camera data at any scale and will not accept any data that includes personal information.

Magna has stated it is committed to protecting personal information and following Canada's federal Personal Information Protection and Electronic Documents Act (PIPEDA), and has implemented a privacy framework which complies with this Act. This compliance includes without limitation: a public-facing statement on Magna's website describing what they are doing and how they protect personal information; this website will be accessible by scanning a QR code on the LMDD; a privacy statement (which will be linked in the preceding webpage) outlining specific privacy protections; and an extensive, internal privacy framework which guides its collection, use and storage of personal information. Magna will also inform the public of this service via various public facing activities including a news release with their retailer customers.

City of Toronto Review Process

Despite no municipal approval authority within the Pilot Program – Automated Vehicles Regulation, the Ministry of Transportation Ontario and Magna have shared with the City all the information submitted in support of this AV pilot application. The Ministry of Transportation specifically asked the City's Transportation Services Division to provide input for the Ministry's consideration in their review of the Magna application.

Materials shared include a detailed response to the City's *Guidelines for Submitting a Work Zone and Law Enforcement Interaction Plan to the City of Toronto*. Magna has also met twice with City staff, including a two-hour workshop for a detailed review of the deployment plan. In their review, Transportation Services staff engaged the broad range of perspectives represented on the City's Automated Vehicle Interdivisional Working Group (AV-IDWG). This group has members from all City Divisions as well as several City agencies. The AV-IDWG has met two to four times per year since 2018 to discuss developments in automated vehicles and related emerging transportation technology, and to contribute to development of the City's Automated Vehicle Tactical Plan and the *Guidelines for Submitting a Work Zone and Law Enforcement Interaction Plan to the City of Toronto*.

For the review of this Magna application, the AV IDWG invited a variety of Transportation Services subject matter experts in traffic operations, curbside management and work zone coordination.

Table 1: Automated Vehicle Inter Divisional Working Group

City Divisions	
• City Manager's Office • City Clerk's Office • Transportation Services • Technology Services • Legal Services • Insurance and Risk Management • City Planning • Toronto Fire • Toronto Paramedic Services • Economic Development & Culture • Corporate Services • Corporate Finance • Engineering & Construction Services • Environment, Climate & Forestry	• Financial Planning • Fleet Services • Municipal Licensing & Standards • Office of the CISO • Revenue Services • Social Development, Finance & Administration • Solid Waste Management Services • Toronto Employment & Social Services • Toronto Public Health • Transit Expansion
Agencies, Boards & Commissions	
• Toronto Police Service • TTC • Toronto Parking Authority	• Exhibition Place • Toronto Zoo

The AV-IDWG workshop with Magna raised questions and discussion on a variety of key topics including:

- safety of pedestrians, cyclists, and other Vulnerable Road Users, including its ability to accurately detect and respond to all humans of all skin tones and sizes, and regardless of mode of travel (e.g. pedestrian, bicyclist, or other);
- the vehicle's ability to integrate into and operate on heavily travelled roadways;
- ability to obey traffic laws and regulations while completing deliveries;
- how traffic laws apply to the vehicle and the supervisors in the chase vehicle in collisions and parking scenarios;
- how the vehicle will respond to emergency vehicles, and its ability to maneuver safely in such cases; and
- what measures are on-board the vehicle to prevent tampering and ensure appropriate maintenance of temperature for food deliveries.

Magna's Work Zone and Law Enforcement Interaction Plan was circulated to all emergency services representatives. Magna has committed to further meetings with, and providing training materials for Toronto Fire, Toronto Paramedics and the Toronto Police Service, to discuss details of what first responders can expect to experience when encountering the LMDD and its chase vehicle, and safety information (e.g. battery safety) for responding to incidents. Magna's primary tactic for interacting with law enforcement, work zones and other unconventional traffic situations is to use the remote operator to proactively take control and navigate the LMDD through the situation.

Information provided by Magna identified a list of mitigation measures which have been designed specifically to reduce risk to public safety and minimize potential impact on traffic/mobility of other road users. These mitigation measures are not features of the vehicle's automation system but rather operational decisions to be applied during Magna's pilot.

Risk mitigation measures include:

No Left Turns
- Safer, based on academic literature and publicly collected data.
- Reduces chance that vehicle will be separated from the 'chase vehicle' and operators; reduces chance of collision.
- Decreases the complexity of decision-making required of the automated driving system.
- Reduces chance that LMDD will contribute to traffic delays.

Slow Speed of Vehicle and Low Speed Roads:
- The LMDD operates at a maximum of 32km/h and will not operate on roads with a speed limit of greater than 40km/h. This reduces the chance of a collision by avoiding streets where there might be a large speed differential between vehicles and because slower speeds improve reaction time.
- Lower vehicle speed is a major contributor of reduced fatality and serious injury risk for vulnerable road users and motorists, as identified in the academic literature.

Low Vehicle Weight
- Reduces potential consequences of a collision.
- Magna reports the LMDD is small and light enough that the safety chase supervisor can move it to the side of the road if there is an instance where one of these LMDDs fully shuts down.

Chase Vehicle and Remote Supervision:
- Each LMDD will be followed by a conventional motor vehicle with both a human driver, and a human passenger ('safety chase supervisor') who is equipped and trained to use an emergency stop function and to move the LMDD to the side of the road.
- A secondary supervisor (located at a remote location within Toronto) has visibility of the LMDD's environment, provided by the 360-degree camera and can fully control the LMDD's operations to navigate challenging situations.
- The safety chase supervisor and the remote supervisor have an active voice link with one another at all times.
- Reliance on these human-controlled interventions to address a range of events which are low probability but potentially significant underlies Magna's response to many questions that were raised by staff regarding safety and risk management.

Liability Insurance
- $5M per incident as required under the *Highway Traffic Act*

Following the review of Magna's information and the discussion with the AV-IDWG, City staff submitted a letter to the Ministry of Transportation with input focused on operational-side mitigation measures. This included i) reinforcing that the above-listed measures proposed by Magna be specifically identified in any approval documents; and ii) recommending some Toronto-specific location and time of day restrictions to avoid particularly busy corridors, avoid delaying TTC shuttle buses in the event of planned or unplanned subway disruptions, enhance safety while crossing major arterial roads, and prevent conflict with winter maintenance activities. Staff further requested that Magna provide training materials for emergency services personnel and share data collected on the performance of the LMDDs and impact on curbside spaces.

Conclusion

Magna has provided various descriptions and reassurances of how the LMDD is designed to operate and the operational approach they will apply during this pilot which they believe collectively address any risks. The information in this report and its attachments is based on what was provided by Magna and does not represent a staff opinion on the capability of Magna's LMDD's automated driving system in navigating traffic conditions in Toronto. The proposal includes a variety of mitigation measures which will help manage the unknown factors regarding the vehicle's performance in dense urban areas.

Based on experiences in the United States, it seems clear that pressure will grow over time to deploy vehicles with various types and levels of automation on Toronto streets. Testing an automated delivery vehicle under the MTO's AV pilot will provide a benchmark for future engagement of this kind. This modest pilot with low-speed vehicles is an important opportunity to increase our knowledge on the state of the technology.

Transportation Services appreciates the transparency and respect for municipal perspective that has been shown by both the MTO and by Magna during discussions regarding this application, and the time afforded to consult broadly with affected and interested Divisions and Agencies. Staff believe it is in the City's best interest to engage in this process to influence conditions of the license and to further our understanding of AVs. This opportunity will allow us to learn about the impact of AVs in Toronto while also supporting an Ontario-based manufacturer to develop its expertise in this competitive field.

CONTACT

Elyse Parker, Director, Policy, Data & Strategic Initiatives, Transportation Services, 416-338-2432, Elyse.Parker@Toronto.ca

SIGNATURE

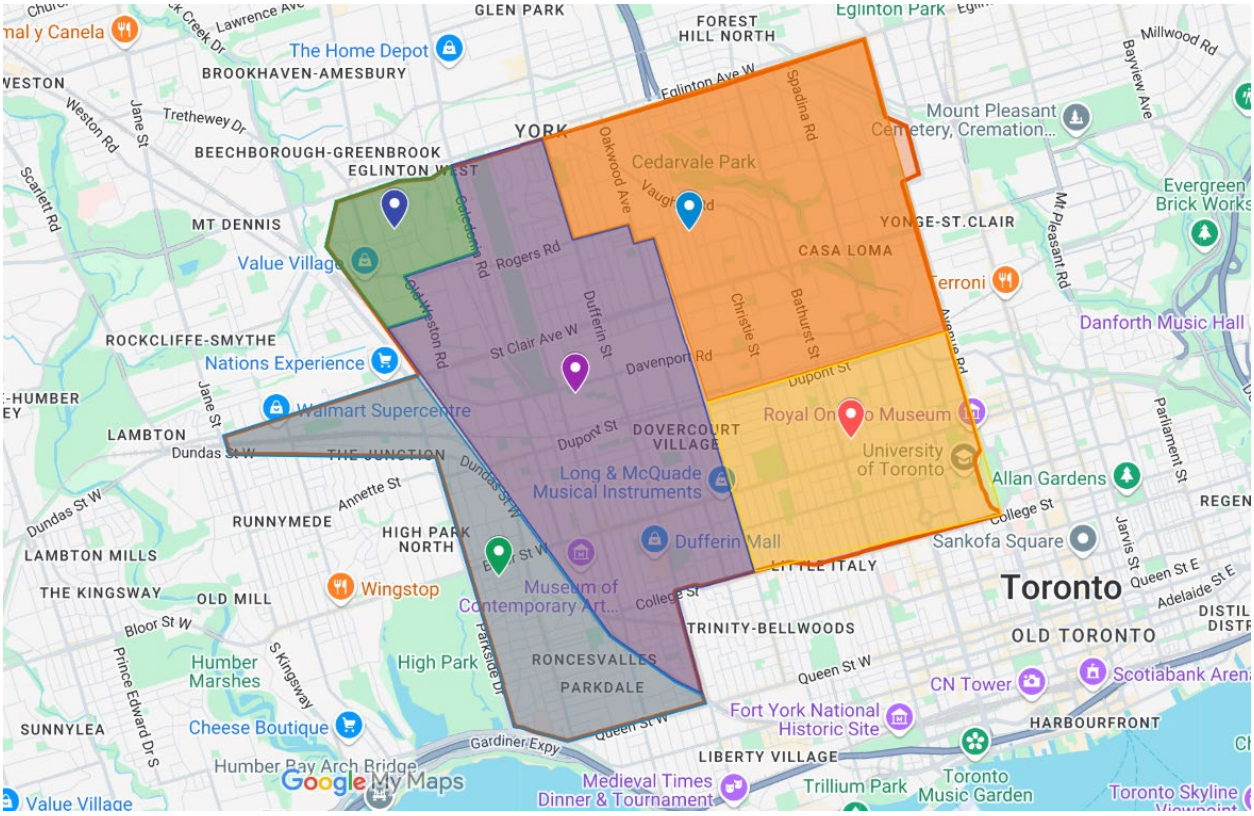
Barbara Gray
General Manager, Transportation Services

ATTACHMENTS

Attachment 1: Image of the Magna LMDD during operations in Michigan
Attachment 2: Map of Proposed Toronto Deployment Area
Attachment 3: Magna's Explanation of How the LMDD Functions

Attachment 1: Image of the Magna LMDD during operations in Michigan

Attachment 2: Map of Proposed Toronto Deployment Area



Attachment 3: Magna's Explanation of How the LMDD Functions

Automated Driving System (ADS): We have utilized a wide range of sensors across the electromagnetic spectrum (eg. lidar, radars, cameras) consistent with leading autonomous vehicle developers, supported by GPS and audio sensors, as well as redundant components and functionality, to reduce environmental interference and maximize the effectiveness of perception functionality. We have also implemented advanced algorithms for perception and control of common road objects, among other technologies and sub-systems. It has a 360-degree horizontal field of view with overlapping fields across each of the sensors, and the range of object detection is at least 50 meters, and for certain sensors, at least 100 meters, which are sufficient given the Vehicle's maximum velocity of 32kph. The ADS is designed to maneuver or brake even if it cannot classify an object, ensuring safety.

The operational approach of the Vehicle prioritizes the safe flow of surrounding traffic (vehicles, cycles, pedestrians) through several key strategies and design features:

1. Compliance with Road Regulations:
    - The ADS is designed to comply with applicable road regulations and drive in a manner customary with other road vehicles, including integrating smoothly into the existing traffic flow without causing disruptions.
    - As this is a goods delivery vehicle for consumer households, and compliance with provincial laws and City of Toronto by-laws involves applying multiple rules and interpreting available curb control signage, a combination of detailed mapping and human control of a Vehicle in the last few metres of a delivery is anticipated for the foreseeable future.
2. Low-Speed Operation:
    - The Vehicle operates at low speeds (at or below 32kph) on lower speed roads (typically 30 or 40kph maximum), which reduces the risk of collisions and allows for safer interactions with other road users, including motorists, pedestrians and cyclists.
3. Object Event Detection and Response (OEDR):
    - The Vehicle is equipped with a comprehensive sensor suite (cameras, lidar, radar, ultrasonic sensors, GPS modules, audio sensors) that provides a 360-degree horizontal field of view. This allows the ADS to detect and respond to objects and events in the driving environment effectively.
    - The ADS tracks object, object location, classification, and velocity, enabling it to detect a wide variety of pre-collision scenarios and take appropriate actions to avoid collisions.
4. Redundant Safety Systems:
    - Safety-critical systems have redundancies, including on-board vehicle power, braking, and ADS. These redundancies are designed to enable the Vehicle to maintain safe operations even in the event of a system fault.
5. Human Supervision and Control:
    - The Controlled Fleet includes trained human supervisors (Remote Supervisors and Safety Chase Supervisors) who can take control of the

Vehicle if necessary. This human oversight ensures that any unexpected situations can be managed promptly and safely.

6. Deferential Driving Behavior:
    - The ADS is designed to be deferential to other drivers, including in situations such as four-way stops. This behaviour helps to prevent confusion and avoid disruption of the normal flow of traffic.

Operational Design Domain (ODD): ODD includes the circumstances in which the Vehicle will be able to operate in Automated Mode, including, but not limited to, any constraints related to road types, weather, speed restrictions, and traffic conditions:

Vehicles controlled by ADS will only be used in deployed areas designated by the Controlled Fleet and after passing qualification and validation criteria and testing determined by the Controlled Fleet ("Deployed Areas").

While a Deployed Area will typically be within the ODD, certain environmental conditions may cause a Deployed Area to be ineligible for Vehicle and ADS usage (eg heavy snowfall). Similarly, areas in cities outside Deployed Areas may be within the ODD, but until Magna passes qualification and validation criteria to meet safety objectives within such areas, they are ineligible for Vehicle and ADS usage. The ODD is expected to expand over time as a result of continuous improvement activities, and currently includes:

- Road type: Surface roads and laneways, except for: (1) marked freeways/motorways/highways, (2) radial roads, and (3) distributor roads, in each case with speed limits equal to or in excess of 60kph (collectively, "high speed roads") as well as (4) sidewalks and other pedestrian oriented paths and (5) bike lanes (collectively, "VRU areas"). Also included in ODD:
    - Crossing high speed roads or VRU areas is included in ODD. Parking lots and private roads are included in ODD but will be managed with the Controlled Fleet trained human supervisors.
    - Driveable area geometry: roads which are straight, curved, level, up-slope under 20 degrees and down-slope under 20 degrees, unless environmental conditions are snowy or icy, in which case the Vehicle will be operated by the Controlled Fleet trained human supervisors. No restrictions on transverse plane if included in the Deployed Area.
    - Two-way and one-way streets. - Speed restrictions: No travel in excess of 32kph. - Typical traffic conditions: Included in ODD, except as noted in "Atypical traffic conditions" below.
    - Lane width or markings: No restrictions. - Atypical traffic conditions (eg construction work zones, law enforcement or first responders in street, etc): Not included in ODD (ie Vehicle will avoid or switch to human operation of Vehicle).
- Bridges, level rail crossings, under-grade rail crossings, tunnels: No restrictions if included in Deployed Area.
- Road surface: concrete, asphalt and other pavement included. Not included in ODD is grass, dirt or gravel.

- Environmental conditions:
    - Daytime / Darkness: Daytime and, to the extent lit by artificial lighting determined acceptable, darkness.
    - Rainfall: None, light or moderate included in ODD. Heavy rainfall is not included in ODD; Vehicle operation will be paused.
    - Snowfall: None or light snowfall included in ODD. Moderate or heavy snowfall is not included in ODD; Vehicle operations will be paused.
    - Accumulated snow or ice on roadways: None or light, provided that road markings can be determined. If no road markings are visible, Vehicle operations will be paused.