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Councillor Paula Fletcher, Chair
Infrastructure and Environment Committee
City of Toronto
100 Queen Street West
Toronto, ON M5H 2N2

cc: Councillor Dianne Saxe
Councillor Gord Perks
Barbara Gray, General Manager, Transportation Services
Elyse Parker, Director, Policy, Data & Strategic Initiatives, Transportation Services
Jennifer Niece, Manager, Strategic Policy and Initiatives, Transportation Services
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RE: Automated Vehicle Pilot Deployment in Toronto Under the Highway Traffic Act
Agenda item: IE22.1

Dear Councillor Fletcher and Members of the Infrastructure and Environment Committee,

I am writing to you as the Executive Director of the Urban Robotics Foundation (URF), a global non-profit helping cities prepare for the deployment of public-area-mobile robots (PMRs).

Given the current pilot deployment of mobile delivery robots in several of Toronto's wards, I have concerns involving *intersection, jaywalker, and road safety* that I share, below.

I express those concerns to the City of Toronto as a URF member after reviewing the April 24, 2025 Toronto IEC Report for Action "*Automated Vehicle Pilot Deployment in Toronto Under the Highway Traffic Act,*" which 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.* (p.11)

I have the following concerns:

Following a larger vehicle

While delivery robots that navigate on the sidewalk experience the greatest single safety threat when entering the crosswalk, due to right turns on red, the subject Magna robots operate on the roadway rather than the sidewalk. This

means Magna devices would only encounter crosswalks as they pass through an intersection, or as they themselves turn right on red. Magna's robots pass over crosswalks rather than traverse them.

Nonetheless, a specific intersection risk critically associated with a Magna-type PMRs is when ***following a larger vehicle*** through an intersection. When a considerably smaller vehicle follows a much larger vehicle, the smaller vehicle may easily be occluded from the sight lines of the driver in an opposing motor vehicle that is turning left. The left turning vehicle, if in a hurry or careless, risks clipping the robot if it is occluded until the last moment.

Jaywalkers

Jaywalking behaviour is common, sometimes careless, and often a source of "edge-cases" relative to robotic machine vision. Two substantial robotaxi companies, Uber ATG and GM Cruise, have already been taken out of the robotaxi industry by crashes with careless jaywalkers. Each company endured staggering losses.

While the safety risks are much lower for Magna's robots (due to their lower momentum compared to a robotaxi at seven times the weight of a Magna robot), because the potential value of the subject pilot to each of Ontario, Toronto, and Magna is very high, this risk remains existential in this early commercialization phase.

While the probability of an outlier jaywalker mishap should be very low during such a cautiously planned pilot, recall the recent "low probability" AV mishap in Whitby (p. 5 of the IEC report; not involving a human jaywalker). My point is that outlier events will happen on the roadway, and jaywalkers are an important source of such outliers.

Three wheels

In addition to interactions with other road users, I also have mechanical road-safety concerns.

The 700 lb Magna robot runs on three wheels. The two front wheels on an axle are the powered wheels; the single back wheel is a support wheel.

A 1982 SAE technical paper, "Three Wheeled Vehicle Dynamics" (820139) indicates that among 3- and 4-wheel designs tested for that paper "the 3-wheeled vehicle with two wheels on the front axle" is the least stable. The full context is:

> "Comparisons are made between a 3-wheeled vehicle with two wheels on the front axle, a 3-wheeled vehicle with two wheels on the rear axle, and a standard 4-wheeled vehicle. Each vehicle's lateral stability, rollover stability during lateral acceleration, rollover stability while braking in a turn, and rollover stability while accelerating in a turn are determined. It is shown that for lateral stability, the 3-wheeled vehicle with two wheels on the rear axle is more stable than the 4-wheeled vehicle, which is in turn more stable than the 3-wheeled vehicle with two wheels on the front axle."

Accordingly, the Magna design *may* be relatively the least laterally stable among potential 3- and 4-wheel designs. Of course, *I do not know whether Magna's designers have defeated this problem*. While I assume the Province may have already examined Magna's stability testing data, it would behoove the City to ask. I appreciate that the Province is guiding this pilot, but the City may be left with the task of addressing crash-related traffic matters.

Single wheel

If the two front (powered) wheels were to straddle a pothole of a few inches in depth in such a way that the back wheel were to be caught in that pothole, this could make the robot unstable (sudden swerve, tip-over, or worse) at its middle or higher speeds, or if the wheel were torn off. This may not happen very often, and perhaps not at all during the pilot, but someday, it will.

An early observation

A primary navigation focus for mobile robotics is "don't hit anything." Toward that concern, and in the case of this pilot, the plan is for humans in a chase vehicle able to stop the robot and have a human to push it to the side of the roadway. There is some comfort in that precaution from a test perspective, although using a chase car has its own problems such as adding more traffic, additional sight line occlusion to the smaller vehicle, separation at light changes, and risks to the human attendant that exits the chase car to enter the street and work in a potentially risky traffic space. We all know this arrangement is not sustainable, rather, my larger point is that there are also many things which the chase vehicle cannot prevent, but also need to be anticipated from the City's and Province's perspectives.

While it is reasonable to believe that these robots are able to travel hundreds of kilometres without incident, the few issues, outlined above, and many others outlined in the draft ISO 4448 standard series would arise if such robots were to be deployed at scale for its intended applications on Toronto streets.

Clearly, our city needs PMR pilots and trials, and Toronto's transportation staff may already be aware of many of these issues, but I want to ensure that the IEC and our City councillors are also aware. I specifically encourage the City to request Magna's stability testing data and failure mode analysis as it may help the City to better anticipate and prepare. At the very least, the pilot may afford an opportunity to gather more such data, as Toronto's roadways may differ from other places Magna has trialed.

Thank you for your attention to these critical safety and system viability matters. The URF welcomes the opportunity to discuss how we might contribute to or collaborate on ongoing standards and regulatory research efforts regarding mobile robotics in Toronto's public spaces and infrastructure.

Sincerely,

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About Public-area mobile robots (PMRs)

PMRs are the specific class of mobile robots that operate in the proximity of uninvolved, untrained, unprotected, and inattentive human bystanders.

"**Bystanders**" is inclusive of pedestrians (and their pets), cyclists, vulnerable road users, and motor vehicle drivers.

"**Operating domain**" is inclusive of urban roadways, sidewalks, parks and trails, as well as within public buildings such as hospitals and airports, or commercial buildings such as hotels, restaurants, and shopping areas.

"**Operation**" is inclusive of logistics (delivery), summer and winter maintenance, security, guidance, and emergency services.

About the Urban Robotics Foundation

URF is a global, membership-supported non-profit started in 2019 and incorporated in 2021 with headquarters in Toronto. We help prepare cities and public facility operators for the arrival of public-area mobile robots (PMRs) by sharing best practices and building a global network of people focused on learning how PMRs (last-mile logistics, safety, surveillance, property maintenance, hospitality, follow me, etc.) can contribute to improved livability in urban ecosystems. We engage in ISO standards drafting, advisory work for our members, authoring guidebooks for deployment and regulation of public-area mobile robots, and developing educational support materials.

Download our free Executive Guide: https://www.urbanroboticsfoundation.org/executive-guide

About Bern Grush

Bern Grush is the Executive Director of the Urban Robotics Foundation and project lead for the draft technical standard ***ISO/DTS 4448 Public-area mobile robots.*** Since 2002, Bern has been involved with transportation-related innovation, standards, and regulatory research for road pricing, parking management, automated vehicles, and now the robots designed to clean and inspect sidewalks, deliver groceries, secure neighbourhoods, operate autonomous wheelchairs at hospitals and airports, and scrub floors at the mall. In 2002, he founded Skymeter Corporation to develop in-car metering for autonomous road and parking pricing, and in 1980, PCI Geomatics to develop AI for image analysis systems for earth-imaging satellites. He holds degrees in Human Factors Psychology from the University of Toronto and Systems Design Engineering from the University of Waterloo. He is the lead author of the 2nd edition of *The End of Driving* (Elsevier, 2025)