City of Thunder Bay
TRANSPORTATION MASTER PLAN

Background Report H:

FUTURE VEHICLE DEVELOPMENTS

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CITY OF Thunder Bay
Superior by Nature

Prepared by
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Table of Contents

1 Introduction

Passenger vehicles are continuing to evolve rapidly and the evolutions in vehicle technology will have impacts on the transportation system and on cities in general. This report examines two evolving technologies: connected and autonomous vehicles (CAVs), and electric vehicles.

These technologies were chosen because connected and autonomous vehicles are likely to become mainstream within the timeframe of this Transportation Master Plan (TMP) and have the potential to significantly influence transportation planning, while electric vehicles are already available, increasingly affordable, and the subject of government incentive programs. This brings both challenges to address and opportunities to harness and support broader city building goals that are at the core of the TMP.

The report first provides background information on each type of technology and then outlines planning considerations for each.

1.1 Background

What are Connected and Autonomous Vehicles?

Connectivity refers to the ability to communicate with other vehicles, traffic signals, smartphones, and more. This communication can aid safety and traffic management goals. Autonomy is the capability of sensing the immediate environment and navigating with little human input. Autonomy can vary with the most sophisticated being self-driving vehicles; more basic levels of autonomy can include semi-autonomous driver warning systems that intervene only to avoid collisions, vehicles with adaptive cruise control, parking assist and lane keeping assist.[1] These basic levels of autonomy are features that are already available on some of today's vehicles.

Vehicles that are connected and have high levels of autonomy have the highest potential to significantly alter transportation and land use patterns.[2] As such, this report will focus on full self-driving vehicles, which could be in widespread use

[1] Automatic cruise control helps the vehicle maintain a pre-set speed similar to conventional cruise control, but the vehicle can also adjust the speed to maintain a safe following distance. Parking assist steers the vehicle into a parking spot without driver intervention. Lane keeping assist steers the vehicle back into the lane if the vehicle begins to drift out of it.

[2] IBI Group (2017). "A Driverless Future… It's Not Just About the Cars." Retrieved November 15 2017 from http://www.ibigroup.com/2017/01/30/a-driverless-future-its-not-just-about-the-cars/

by 2030, but implementation depends on both technology and governing legislation.[3]

What are Electric Vehicles?

Electric vehicles (EVs) are vehicles that operate entirely on electricity, or in the case of a hybrid vehicle, alternate between conventional fuel and electric power to increase fuel economy and reduce emissions. EV technology can also be combined with CAV technology.

Conventional EVs and hybrids are commercially available and becoming increasingly more affordable. EVs can be charged using standard household plugs and can also be charged using charging stations that provide a faster charge. Cities around the world, including Thunder Bay, are beginning to install charging stations at both public and private facilities.

2 Planning Considerations

2.1 Connected and Autonomous Vehicles

Connected and Autonomous Vehicles (CAVs) have the potential to bring many benefits to Thunder Bay, but they also present risks if the technology is not properly managed.[4]

Potential benefits may include:

- Reducing the frequency and severity of motor vehicle collisions, as most vehicle collisions are caused by human error;
- Increasing road capacity and reducing pavement widths, as connected vehicles can travel closer together in narrower lanes;
- Providing mobility and independence to rural, lower density, or other mobility-challenged communities that do not have the population density to support traditional transit service;
- Relocating parking lots and driveways farther from homes and businesses, as fully autonomous vehicles will be able to drive away and park themselves; and
- Reducing the need for vehicle ownership, as autonomous vehicles could be owned by a third party and provide service through a subscription based arrangement.

[3] IHS Automotive (2014). Automotive Technology Research: Emerging Technologies: Autonomous Cars – Not if, but when.
[4] IBI Group (2017). A Driverless Future…It's Not Just About the Cars.

Despite the potential for benefits, there are also numerous potential challenges associated with CAVs. Potential challenges may include, but are not limited to:

- Technology is still in its early stages and is not ready for a widespread implementation;
- Potential to increase vehicle-kilometers travelled and encourage urban sprawl as people may be able to tolerate longer commutes and more frequent car trips;
- Short trips that could be made by active transportation and/or public transit may be replaced by on-demand CAV services and/or individually-owned CAVs;
- If a large portion of CAVs are individually-owned, road congestion could increase significantly with empty vehicles using the roadway;
- More expensive connected infrastructure to support CAVs; and
- Municipal infrastructure maintenance requirements may increase as CAVs may require better lane markings, constantly updated mapping, and other increased maintenance activities. Additionally, it is unclear how CAVs will operate in winter weather and that may impose additional winter maintenance costs on municipalities.

It is important to note that potential benefits and drawbacks are context specific. For example, potential reductions in traffic congestion will be less pronounced in a city that does not have roads that are experiencing capacity constraints. The potential benefits and drawbacks of the vehicles and the design and policy interventions required also depends on how widely CAVs are adopted at a particular location.

It is also important to note that CAVs should not replace conventional public transportation services in cities. Conventional transit is still the most efficient way of moving large numbers of people in urban areas, though it should be noted that transit will face increased competition from CAVs. Transit service will need to be competitive to meet potentially heightened customer expectations.

2.2 Getting Ready for Connected and Autonomous Vehicles

Given that this technology is in its early stages and there are many unknowns (Ontario only began allowing CAV testing on its roads in 2016) it will be important for the City to monitor CAV developments and plan for ways to leverage benefits and minimize drawbacks.

For example, CAVs should be leveraged for shared transportation services before they become widely affordable for personal use. As CAVs become more readily available, it will also be important to de-incentivize behaviour with

negative consequences, such as using CAVs for short trips that would otherwise be made by active modes. It will also be important to disincentivize behaviour that results in personally-owned empty vehicles driving around the city.

There are also potential land use opportunities that the City can consider when and if CAVs become more common in Thunder Bay. Because fully autonomous CAVs will be able to park far from the destinations of their occupants there may be opportunities to re-purpose underused infrastructure, such as parking lots near the cores. CAVs also require less road space than conventional vehicles, increasing the available capacity on a road and potentially freeing up road space for other purposes, such as streetscape improvements or bike lanes, if measures are in place to manage the circulation of empty vehicles.

Regardless of the specific developments and influences of CAV technology it will be important to use the vision and goals of the TMP to inform policy and infrastructure decisions in the face of technological change. This will help ensure that the arrival of CAVs contribute to positive rather than negative outcomes.

3 Electric Vehicles

3.1 Infrastructure

Electric vehicles (EVs) and hybrid electric vehicles are increasingly becoming more affordable and therefore more common.

The Province of Ontario introduced an electric vehicle incentive program in 2010 to encourage EV adoption. The Province also has an electric vehicle charging station incentive program to encourage individuals and businesses to install charging stations. While charging can take place at home overnight with a basic household plug, a network of public charging facilities can help make electric vehicle use more convenient and provide drivers with an assurance that they will not be stranded when their batteries run low.

There are three different types of charging stations:

- **Level One:** Level one charging stations are basic household or workplace outlets. Vehicles typically charge in 8 to 20 hours, depending on the vehicle type.
- **Level Two:** Level two stations can charge a vehicle in roughly four to six hours, and are appropriate for workplace locations where vehicles will be parked for most of the day.
- **Level Three:** Level three charging stations can charge a vehicle battery up to 80% in 30 minutes and are appropriate for locations where drivers will be parked for a shorter time period, such as a grocery store.

Thunder Bay could become an EV friendly city by installing charging stations, such as the one pictured in Exhibit 3.1, at city-owned parking lots and other city-owned facilities, and by encouraging private businesses to do the same. Other cities in Ontario, including Ottawa and Toronto, provide charging stations at city-owned facilities, with some charging a fee to use the service.

Although vehicles that are 100% electric rely exclusively on charging, hybrid-electric vehicle drivers also stand to benefit from a wider network of charging stations.

Exhibit 3.1: Typical Electric Vehicle Charging Station

Photo credit: IBI Group

3.2 Cold Weather Climates

A common concern in Canadian cities is the impact of cold weather on electric vehicle battery life. In colder weather conditions, the range of electric vehicle/hybrid batteries decreases, as does the range of conventional gas engines. One study estimated that in extreme cold temperatures of -25°C, the range of an electric vehicle, in this case the Nissan LEAF base model, can decrease from approximately 130 km to 85–90 km (decrease of 34%).[5] Another source reported that the range can drop to as low as 75km (decrease of 42%).[6]

[5] Allen, M. (2013). “Electric Range for the Nissan Leaf & Chevrolet Volt in Cold Weather,” fleetcarma. Retrieved December 16, 2016 from <http://www.fleetcarma.com/nissan-leaf-chevrolet-volt-cold-weather-range-loss-electric-vehicle/>

[6] Prystupa, M. (2012). “Electric cars can handle Canadian winter.” CBC News. Retrieved on December 16, 2016 from < http://www.cbc.ca/news/canada/manitoba/electric-cars-can-handle-canadian-winter-1.1199058>

While the drop in range is significant, many electric vehicle drivers do not use their vehicles for long-distance trips.[7] As a point of comparison, the US government has estimated that under cold conditions fuel economy decreases by roughly 12%, and as much as 22% for very short trips (3 to 4 miles or 4.8 to 6.4 km).[8]

Most Canadians have daily commutes that fall within the range of an electric vehicle even with a reduced winter range.[9] Thunder Bay is no exception. According to 2011 National Household Survey data, 52% of work trips in Thunder Bay are 4.9km or less. [10] While drivers use vehicles for purposes other than driving to work, it is clear that daily travel needs for many can be met within the range of an electric vehicle.

3.3 Reducing Vehicle Use

As with any new transportation technology, electric vehicles come with benefits and drawbacks. Electric vehicles have the potential to significantly reduce greenhouse gas emissions if widely adopted, but they also have the potential to encourage vehicle use, especially when combined with CAV technology.

The need to reduce car use in urban areas is often discussed in terms of reducing greenhouse gas emissions. If that incentive is no longer present, there is a risk that driving will increase. However, there are many benefits to reducing private vehicle use that extend beyond the need to reduce emissions. Encouraging healthy active lifestyles and compact development are things that benefit from and contribute to a reduction in private vehicle use. These should be encouraged whether or not private vehicles produce harmful emissions.

It will be important for the City to continue to develop its active transportation network to ensure that healthy transportation options that support a compact urban form and safer streets can flourish. Active transportation and transit will remain far more space efficient ways of moving people throughout the city.

[7] Range issues are not significant for hybrid electric vehicles, as drivers can use conventional fuel.
[8] United States Department of Energy. Retrieved on May 17, 2018. <https://www.fueleconomy.gov/feg/coldweather.shtml>
[9] Ibid.
[10] IBI Group analysis of NHS 2011 data table 99-012-X011064