DILLON CONSULTING

TOWN OF AJAX

Community Climate Study

Emergency Preparedness and Response (FINAL)

October 2018 – 18-7286

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1.0 Introduction

1.1 Background

The Town of Ajax (the Town or Ajax) has been impacted by significant climatic events which, among other things, have caused property damage, disruptions to transportation and energy systems and resulted in economic and social impacts to the community.

The Town identified a need to better understand the threats and risks faced by the community as a result of changing trends associated to the following three climate variables: severe weather, temperature and precipitation. Three main community outlooks were identified of particular concern to the Town and included overland and stormwater flooding, threats to the natural environment, and impacts to emergency preparedness and response services. The purpose of Town of Ajax Community Climate Study is to provide a GIS-based tool for the Town of Ajax to assist in identifying, analyzing, evaluating and ultimately managing climate change based risks as part of an overall Climate Change Adaptation Plan being developed by the Town.

1.2 Study Area

The Town of Ajax is located east of the Greater Toronto Area within Durham Region. The Town is primarily situated between Duffins Creek and Carruthers Creek, with its southern border along the shorelines of Lake Ontario.

The Town covers an area of 67km^2 and is a predominantly suburban area, with greenbelt lands located to the east and north. According to the 2016 Census, Ajax is home to approximately 120,000 residents, the majority of which live within the west and south areas of the town. Due to the presence of the two major creeks noted above that outlet to Lake Ontario, the Toronto Region and Conservation Authority (TRCA), and the Central Lake Ontario Conservation Authority (CLOCA) regulate, and have jurisdiction over development within the lands adjacent to the creeks.

1.3 Purpose of the Study

The following areas have been reviewed and analysed spatially, provided data was available.

Demographics

Since climate change does not impact all groups equally, this study has identified a number of priority populations who are at an increased risk of having health related factors associated with climate change including threats to life safety and well-being. The extent to which an individual is affected by these stressors depends on their level of sensitivity, their exposure and their adaptive capacity during or after an emergency situation. These identified populations can be persons with mobility limitations, cognitive limitations, persons with developmental disabilities, or those generally who are unable to move on their

own due to their own physical limitations or due to restraint. For the purposes of this study the impacts of certain climate based scenarios to priority populations was reviewed qualitatively based on data-sets provided by the Town of Ajax.

Local Partners and Resources

Partnerships with local community entities and resources add a valuable component to a successful emergency management process. These partnerships are essential to each phase of an emergency and involve establishing connections that are collaborative in nature. They can include but are not limited to government bodies, faith-based organizations, school boards, local businesses, non-profit organizations and local citizens. While each community will have its own unique partnerships, identifying them early on and fostering them over time will ensure that the community as a whole will be better prepared for emergency situations such as climate change scenarios. This study has identified and qualitatively reviewed potential local partnerships and resources for the Town of Ajax.

Vulnerable Buildings

For the purposes of this study, the term "vulnerable buildings" refers to those occupancies used primarily by the priority populations identified within the Demographics section of this study. They have been identified as both residential and non-residential buildings that are occupied by those individuals. They can include but are not limited to childcare facilities, schools, social housing, affordable housing, senior centres, retirement homes, long-term care facilities, detention centres and emergency shelters. For the purposes of this study, each vulnerable building was assessed quantitatively based on its location within the riverine flooding area or in close proximity to overland flooding extent. The methodology for this assessment is described further in **Section 2**. In the event of overland flooding, transportation via emergency response routes could greatly impede the ability of first responders to reach those priority populations who are most vulnerable to the impacts of flooding. Critical Infrastructure was also identified in this study as any loss of power to these facilities could result in a loss of essential services to members of the community on a local to a more widespread scale.

Transportation Systems

Transportation systems susceptible to failure as a result of increased precipitation and severe storm may affect the ability of emergency vehicles to respond to an incident and impact both evacuations routes and public transit. During severe weather and precipitation events, road networks may become impassable for periods of time due to flooding, damage to infrastructure, freezing conditions, as well as downed hydro wires and trees. This study identifies roads and evacuation routes and discusses challenges that may be experienced in the event of a weather related emergency related to the climate change stressors of precipitation, extreme temperatures and severe storms.

2.0 Approach

Identifying risks and their contributing factors assists communities in defining their needs and circumstances. Emergency Management Ontario defines risk as a product of the probability of the occurrence of a hazard and its consequences.[1] For the purposes of this study a climate change based scenario is almost certain to occur given the Town of Ajax has been impacted by a number of climatic events in the past with associated consequences of property damage, energy and transportation disruptions, injury and economic impacts.

Given the data available, risk was assigned to vulnerable buildings using a binary approach. The Risk Assignment for vulnerable buildings was either high or low based on the building's proximity to riverine flood lines and overland flooding extents based on existing and climate projections. Those buildings located inside the riverine flooding areas, inside or close proximity to overland flooding were designated as high risk, due to the potential for a threat to life safety, large loss of life, and/or evacuation/displacement of a large number of persons.

This risk assignment relates to the priority populations living in or being served by the building to be impacted. Comparatively, those buildings outside the riverine flooding areas, without proximity to overland flooding extents have a lower risk of flooding and therefore less potential for risk to life safety or conditions.

In addition to vulnerable buildings, risk was assigned to census dissemination areas throughout the Town based on population density – the amount of people in a given area. Three categories of risk were assigned to define population density. This is based on the assumption that the higher the population density for a given area the higher the consequence of climate change on the life safety of those individuals.

[1] Source: "Hazard Identification and Risk Assessment for the Province of Ontario. "Ontario Ministry of Community Safety and Correctional Services. Last Modified 25 May 2016: https://www.emergencymanagementontario.ca/english/emcommunity/ProvincialPrograms/hira/hira_2012.html#P372_9816

3.0 Demographics

Climate change presents significant risks to human health and well-being. However, not all demographic groups are impacted equally. The Town of Ajax has identified a demographic to be known throughout this report as "priority populations". The term "priority populations" is associated with the Ontario Public Health Standards which states "the board of health shall use population health, determinants of health and health inequities information to assess the needs if the local population, including the identification of populations at risk, to determine those groups that would benefit most from public health programs and services (i.e. priority populations)."[2] . For the purposes of this study, the term priority populations refers to those who may be at increased risk or impacted more severely by the effects of climate change. This study assesses existing emergency response and preparedness programming and services relating to climate change within the Town, and considers those which may be options in the future. Vulnerability to climate variability can be influenced by factors such as an individual's exposure to hazards and stressors, how sensitive they are to the effect of that hazard and their capacity to adapt to a changing climate.[3] Priority populations require particular focus from a fire and emergency service provider, primarily because these individuals are unable to assist themselves in the event of an emergency.

In addition to extreme weather events, climate change involves fluctuations in the duration, frequency and intensity of precipitation as well as deviations from temperature norms. With the rise of heavy rains, intense heat events and other climate variations, there is potential for greater impacts on the outcome of human health, especially to those who are predisposed to health concerns and therefore more likely to be adversely affected. The Ontario Centre for Climate Change Impacts and Adaptation Resources (OCCIAR) has identified an association between the severity and frequency of extreme weather events and an increase in illness and death due to compromised air quality, food and water integrity and vector-borne diseases.[4] Other impacts to human health include death and illness related to extreme heat (from heat waves), freezing temperatures and temperature related illness, as well as an increase in injuries or death associated with natural hazards due to a person's location (i.e. whether or not they live in a floodplain).

[2] Source: Public Health Ontario: https://www.publichealthontario.ca. Accessed September 20, 2018.
[3] Source: "Climate Change Impacts & Adaptation in Ontario: Human Health." Ontario Centre for Climate Impacts and Adaptation Resources (OCCIAR). 2015: http://www.climateontario.ca/doc/RACII/National_Assessment_Syntheses/SummarySheets/Chapter7-Human_Health.pdf
[4] Ibid.

Health Canada has identified seven categories of climate-related impacts to the health and well-being of Canadians. The health impact categories include:

- Temperature Related Morbidity and Mortality;
- Weather Related Natural Hazards;
- Air Quality;
- Food and Water-borne Illnesses;
- Vector-borne Diseases;
- Exposure to Ultraviolet Rays; and,
- Socio-economic Impacts on Community Health and Well-being.

Several of the health impacts identified by Health Canada are captured below in more detail as they relate to the three climate change stressors that guide this report. Where applicable, climate projections made in the Durham Region's Future Climate (2040-2049) report, prepared by SENES Consultants, are referenced in relation to the health impacts associated with climate change and the stressors identified.

3.1 Health Impacts of Climate Change

3.1.1 Temperature Related Morbidity and Mortality

It is almost certain and widely accepted that increases in the frequency and magnitude of warm daily temperatures will continue to take place on a global scale increasing the prevalence of heat waves over most land areas.[5] Elevated temperatures and humidity are contributing factors associated with heat-related illnesses and mortality.

According to the Durham Region's Future Climate (2040-2049) report, the region will experience an increase in number of heat waves overall. For Ajax specifically, the highest difference between the current conditions (2000 – 2009) and future predictions (2040-2049) is seen in the number of calendar days with a maximum temperature of 30 degrees Celsius or more. Extreme humidex days or calendar days that have a humidex value greater than or equal to 40 are shown to increase in the number of days on average across the region. An increase in heat wave and extreme humidex days are likely to increase energy demands on cooling systems and impact the health of those who are more sensitive to high heat levels.

Extreme deviations from temperature norms due to the severity and frequency of heat waves can inhibit the body from regulating its core temperature and lead to respiratory or cardiovascular complications brought on by the heat or exacerbate existing medical conditions, including heat stroke,

[5] Source: "Managing the Risks of Extreme Events and Disasters to Advance Climate change Adaptation." Intergovernmental Panel on Climate change, 2012: https://www.ipcc.ch/pdf/special-reports/srex/SREX_Full_Report.pdf

heat exhaustion and hyperthermia. The health impacts of rising temperatures are compounded by the land use and settlement patterns of individuals living in a particular area. Those living in an urban environment are subject to the *Urban Heat Island* effect which is characterised by a thermal imbalance in the built-up urban environment. This phenomenon arises due to anthropogenic heat production and the prevalence of manmade materials and lack of greenspace within the urban form.[6] Pavement surfacing materials for example, are highly heat absorbent, trapping heat within city surfaces. In an urban heat island, sunlight emitted during the day is absorbed by these materials and is then radiated at night as heat.[7] Therefore, persons living within the urban environment, and in more densely populated areas, are more susceptible to the effects of extreme heat.

Extreme temperatures can indirectly impact a person's health by disrupting infrastructure critical to a functioning community (i.e. energy systems). Higher temperatures can tax existing energy networks as electricity demands for cooling increase, demanding more production from energy generating facilities and infrastructure.

3.1.2 Weather Related Hazards

Weather related hazards are a result of an increase in the frequency and intensity of weather events (tornadoes, thunderstorms, ice storms and flooding) that can result in physical injuries or loss of life, as well as economic loss. For example, fallen branches and limbs, damaged power lines, flooding, and other direct and indirect hazards associated with weather events can pose significant challenges to an individual's well-being.

Indirectly, damage to infrastructure and property can prevent individuals from accessing essential services and resources fundamental to daily life such as disruptions in energy sources, food storage, road infrastructure, water accessibility, and communication infrastructures. Power outage events are commonplace after an extreme weather related event in the winter season especially, during or in the aftermath of ice storms. Lack of power to a household or facility can impact an individual or group's ability to communicate, heat their home (depending on the type of energy source used), refrigerate food, or to power life-supporting medical devices especially if there is no back-up generator present. Weather-related power outages have also been associated with increased injuries and deaths from carbon monoxide poisoning after the occurrence of extreme events due to an increase in the use of gasoline powered generators, heaters and stoves used inside the home without proper ventilation.[8]

[6] Source: "The urban heat island effect, its causes, and mitigation, with reference to the thermal properties of asphalt concrete." Journal of Environmental Management, 2017: https://www.sciencedirect.com/science/article/pii/S0301479717303201
[7] Source: "The Impacts of Climate Change on human Health in the United States." USGCRP, 2016: http://dx.doi.org/10.7930/J0R49NQX
[8] Source: "Infectious Disease, Climate Change and Health." Public Health Institute/Centre for Climate Change and Health, 2016: http://climatehealthconnect.org/wp-content/uploads/2016/09/InfectiousDisease.pdf

Transportation systems such as road networks are a critical component of social and economic vitality of a community. In the case of severe weather events, the functionality of these systems could be compromised. Damage or loss to transportation networks can have negative impacts to emergency response efforts, delaying access to health care, medications and hospitalization. Precipitation events that lead to flooding emergencies can oftentimes force people from their homes, creating situations where evacuation efforts are required. Road networks and public transit routes are susceptible to failure as a result of increased traffic, presenting many challenges to municipal evacuation activities.

Climate predictions for Ajax (Durham Region's Future Climate) show no significant future (2040-2049) increases in freezing rain with high winds. However, the future predictions indicate there will be an increase in days per year that have the potential to create supercells across the region (inclusive of Ajax). With an increase in the severity and intensity of storms and weather events over time, emergency management systems will need to be strengthened and tailored to address the impacts of such events.

3.1.3 Vector-borne Diseases

Diseases caused by pathogens are particularly sensitive to the effects of climate change given that they spend a portion of their lifecycle in the environment outside or away from the confines of their host. In areas with rising temperatures and persistent rainfall, biological changes can occur where typical seasons for some vectors are lengthened and the risk of exposure to vector-borne diseases is increased as transmission periods are prolonged. A vector is "any organism –such as fleas, ticks, or mosquitos – that can transmit a pathogen, or infectious agent, from one host to another."[9] Ticks and mosquitos have been known to transmit an array of pathogens, and given that tick-borne Lyme disease is an emergent trend in Ontario, and that the lengthy recovery period associated with mosquito transmitted West Nile Virus (WNV), these two diseases are highlighted below.[10]

West Nile Virus

The West Nile Virus (WNV) is a vector-borne disease that is sustained through the transmission of the virus between birds, (the natural host of the WNV) and mosquitos, thriving as mosquitos pass along the virus between birds. The infected mosquitos can spread the virus to humans and other animals through a single bite; however, humans cannot pass on the virus to other biting mosquitos because there are not sufficient concentrations of the virus within the person's bloodstream.[11] Once a person is infected with the virus, symptoms vary; however, the majority of those infected do not present any symptoms at all.

[9] Ibid.
[10] Source: "Climate change Increases the Number and Geographic Range of disease-Carrying Insects and Tacks." American Public Health Association: https://www.apha.org/~/media/files/pdf/factsheets/climate/vector_borne.ashx
[11] USGCRP, 2016.

West Nile Virus vectors such as mosquitos are quite sensitive to temperature changes. In order for a mosquito to act as a vector, it must outlive the time required for the pathogen to develop within it.[12] Warmer temperatures are ideal for the lifecycle of mosquito species and it has been observed that higher temperatures accelerate the biological processes that affect transmission seasons. Additionally, wetter environments (such as those created by increased precipitation), create ideal breeding sites for this type of vector, increasing its population with the potential for increased occurrence of WNV transmission.

Climate predications for the Durham Region show an increase in the number of days with heavy rain events throughout, affecting multiple municipalities, with the largest increase occurring in the Port Perry area. For high-intensity, short duration rainfall occurrences, only three events were projected across Durham, one of which is predicted to occur in Ajax.[13] An increase in heavy rainfall in Ajax as well as in surrounding communities will likely produce wetter environments and expand areas inhabited by mosquitos.

Knowledge of the geographical locations of these vectors, and the diseases they transmit, through ongoing surveillance programs is one way through which a community can mitigate the risk and the spread of vector-borne diseases influenced by a changing climate. The Ontario Ministry of Health and Long-Term Care (MOHLTC) mandated that all public health units in the Province are required to implement a WNV control program. Locally, the Durham Region West Nile Response Committee (DRWNVRC) was created to coordinate all WNV response activities in the Durham Region. In accordance with the provincial *West Nile Virus Preparedness and Prevention Plan*, the DRWNVRC created the *Durham Region West Nile Vector Control Plan*. This plan consists of four main components including:

- Adult Mosquito surveillance;
- Larval mosquito surveillance and control;
- Monitoring of human health effects/complaints; and
- Communication/public education.

The Durham Region Health Department's Annual Report (2017) captures the most current confirmed and probable human cases of WNV data collected within the Region as a result of ongoing surveillance and monitoring programs. **Table 1** below provides a summary of such cases over a five year period.

[12] Source: "Potential Impact of climate change on emerging vector-borne and other infections in the UK." Environ Health, 2017: https://www.ncbi.nlm.nih.gov/pubmed/29219091
[13] Source: "Durham Region's Future Climate." SENES Consulting, 2011: https://www.durham.ca/en/living-here/resources/Documents/EnvironmentalStability/DurhamsFutureClimateStudy_Volume1.pdf

Table 1: Summary of Reported Confirmed and Probable Human Cases of WNV within Durham Region (2013-2017)[14]

Year	# of Reported Confirmed Human WNV Cases	# of Reported Probable Human WNV cases
2017	3	0
2016	1	1
2015	1	1
2014	0	0
2013	3	0

Source: Durham Region Health Department

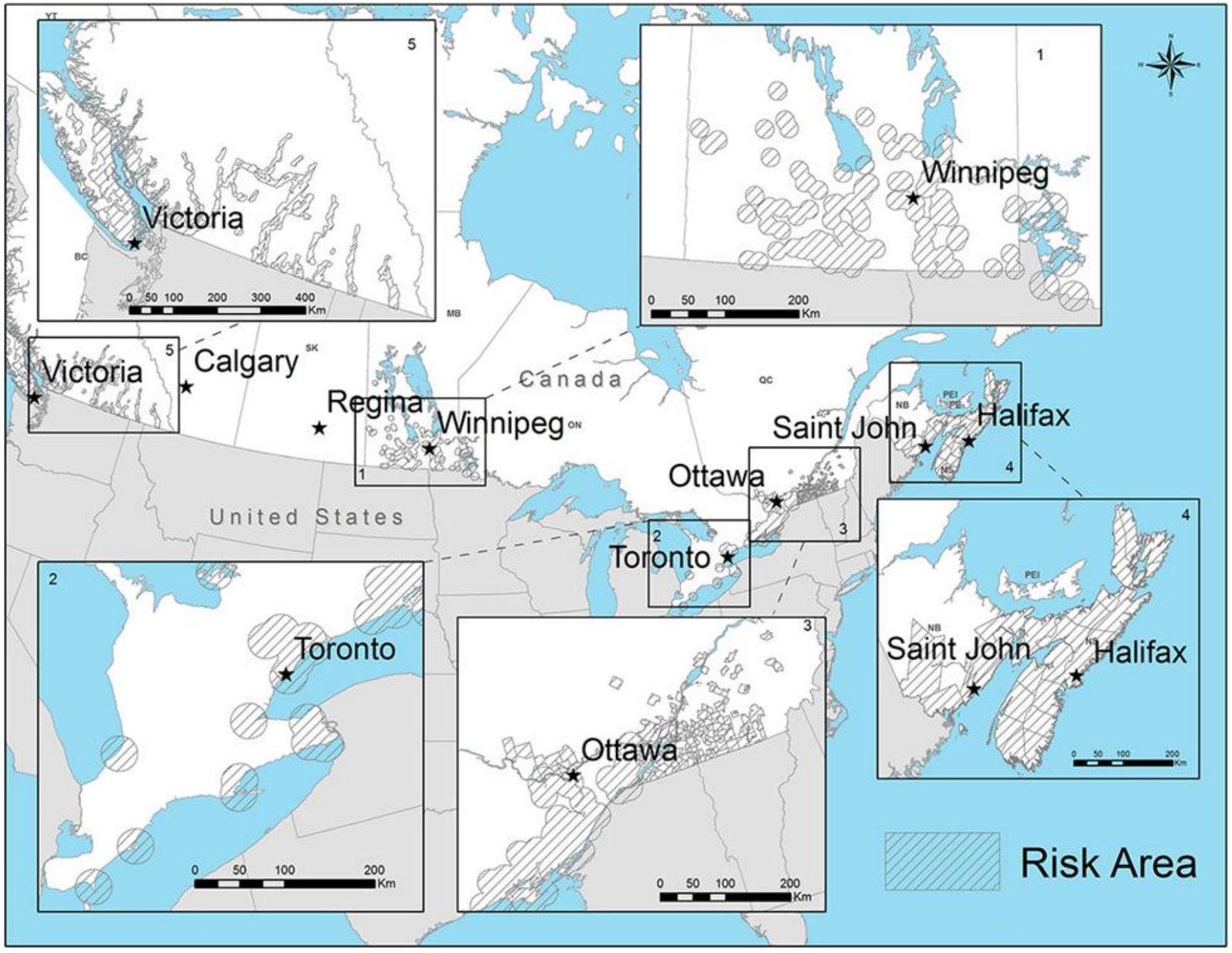
Durham Region had 3 human cases of confirmed WNV in 2017. Meanwhile, the Public Health Agency of Canada reported 155 human cases of WNV in Ontario, and a total of 190 cases for all of Canada.[15]

Lyme Disease

Lyme disease is a bacterial tick-borne disease that is transmitted through certain tick species, known as blacklegged ticks or deer ticks. The surveillance of blacklegged ticks in recent years suggests they are spreading in eastern and central Canada.[16] This information is valuable because on-going surveillance of these species and their geographical distribution provide insight into where the risk of Lyme disease is present. Areas throughout Canada at risk of Lyme disease are illustrated in **Figure 1** below.

[14] Source: "Vector-borne diseases." Durham Region Health Department Annual Report, 2017: https://www.durham.ca/en/health-and-wellness/resources/Documents/VBD2017YER.pdf
[15] Ibid.
[16] Source: "Risk of Lyme Disease to Canadians." Government of Canada, last modified 2018-08-14: https://www.canada.ca/en/public-health/services/diseases/lyme-disease/risk-lyme-disease.html

Figure 1: Lyme Disease Risk Areas Across Canada



(Source: Health Canada)

Temperatures that are too low or too high can have an impact on tick mortality rates however it has been observed that an increase in humidity can increase the tick's ability to tolerate abnormally high temperatures.[17] With the onset of warmer temperatures transmission periods may be extended beyond usual norms. Research has identified that the host-seeking activity of blacklegged ticks ceases in cooler and more humid conditions[18], supporting the possibility that these activities could last longer than previously expected. See **Section 3.1.1** for heat wave and extreme humidex climate predictions for Ajax.

The Durham Region Health Department Annual Report concluded that of the 176 suspected cases in 2017 (either by the public or by health care providers), 117 were confirmed to be blacklegged ticks, with 103 of those blacklegged ticks likely having been acquired within the Durham Region. Eighteen of the total 117 blacklegged ticks tested positive for *Borrelia burgdorferi* (the bacteria that causes Lyme disease), 9 of which were likely acquired within Durham Region. **Table 2** provides a summary of reported human cases of Lyme disease within the Region from 2013 to 2017.

Table 2: Summary of Reported Human Cases of Lyme Disease (2013-2017)[19]

Year	# of Confirmed Human Cases Reported	# of Probable Human Cases Reported
2017	40	8
2016	16	8
2015	11	4
2014	9	3
2013	6	5

Source: Durham Region Health Department

In 2017, there were 40 confirmed human cases of Lyme Disease and 8 probable human cases within Durham Region. **Table 2** depicts a dramatic increase in the number of confirmed human cases of Lyme disease in the Region in 2017 when compared to previous years, stressing the importance of ongoing vector monitoring initiatives.

3.1.4 Other Key Health Impacts

Poor Air Quality

Poor air quality due to smog, pollution, smoke emitted from wildfires and through increases in high temperatures can exacerbate allergies and respiratory conditions, increase the risk of cardiovascular

[17] Source: "The Impacts of Climate Change on human Health in the United States." USGCRP, 2016: http://dx.doi.org/10.7930/J0R49NQX
[18] Ibid.
[19] Durham Region Health Department Annual Report, 2017.

diseases and cause shortness of breath as well as eye, nose and throat irritation.[20] Air pollutants that are harmful to human health are also drivers of climate change (i.e. CO_2 emissions) in that they have a direct effect on the amount of sunlight that is reflected or absorbed by the atmosphere with some pollutants warming the Earth's surface.[21] Air pollutants can be influenced by elevated temperatures as well, for example, ground level ozone has been known to increase as a result of warmer temperatures. Ground-level ozone is a main component of smog which can be associated with a number of negative health effects, including the exacerbation of respiratory conditions and allergies (among others).[22] Areas in Ajax that are particularly vulnerable to smog are the 401 highway and major regional roads, where traffic is more prominent.

More frequent wildfires and longer wildfire seasons have also been associated with rising temperatures. The health and well-being of the general public and first responders are likely to be compromised with increased exposure to air pollutants emitted by more prevalent fire activity. In some instances, smoke from forest fires in the surrounding area can reduce the quality of the air as well as reduce visibility for residents who are not in the immediate vicinity of a wildfire. A more recent example would include the Parry Sound 33 fire that forced evacuations in several municipalities and also reduced the air quality in multiple northern cities due to smoke.[23]

Wildfires or grass fires can also disrupt transportation systems as well, especially in rural areas where a mix of woodlots, bush and grass is prevalent. Rail transportation is particularly vulnerable to disruption in the event of a grass fire. There are two commercial rail lines that run through Ajax; Canadian National and Canadian Pacific and Via Rail provides passenger services.

For priority populations and the general population, the Ministry of the Environment, Conservation and Parks has generated health messages for use during a number of air quality events. The Town of Ajax could utilize this list as a guide to convey health warning to the public in the event of a forest fire or smoke related event.[24] These messages include:

- Stay inside if you have breathing difficulties;
- Be sure the house doesn't get too warm; and
- Wearing a mask is not the best way to protect your health during a smoke event.

[20] Source: "Ontario Climate Change and Health Toolkit." Ministry of Health and Long-Term Care. 2016: http://www.health.gov.on.ca/en/common/ministry/publications/reports/climate_change_toolkit/climate_change_toolkit.pdf
[21] Source: "Air pollution and climate change." IASS: https://www.iass-potsdam.de/en/output/dossiers/air-pollution-and-climate-change
[22] "Air pollution: drivers and impacts.: Environment and Climate change Canada, Date modified: 2017-08-09: http://www.ec.gc.ca/indicateurs-indicators/default.asp?lang=En&n=D189C09D-1
[23] Source: "Smoke from Ontario forest fires impacting air quality in Sudbury and North Bay." CTV News, August 1, 2018: https://www.ctvnews.ca/canada/smoke-from-ontario-forest-fires-impacting-air-quality-in-sudbury-and-north-bay-1.4036859
[24] Source: "AQHI Categories and Health Messages." Ministry of the Environment, Conservation and Parks: http://www.airqualityontario.com/aqhi/health_messages.php

Food and Water-borne Illnesses

Food and water-borne illnesses are expected to increase with the rise in temperature and increased precipitation events brought about by climate change. In general, water-borne illnesses result from exposure to pathogenic microorganisms in the water.[25] A person can be exposed to contaminated water through ingestion, inhalation, and the consumption of seafood. Aside from temperature and precipitation, the toxicity of water can otherwise be attributed to contaminants sourced from human and/or animal waste carried from urban or agricultural centres to surface, groundwater and coastal waters.[26] Contamination can occur when precipitation causes runoff whereby excessive amounts of water flow across the landscape; this runoff can overwhelm storm water and sewer systems and can compromise the integrity of water and wastewater management systems in place.

Extreme precipitation events and the subsequent runoff that could follow, increase nutrient loading in drinking water sources (and recreational waters), which can result in an increase in algal toxin blooms.[27] Likewise, temperature or increased water temperature can promote the growth of algae. With the onset of a changing temperature profile, the potential for an increase in algae blooms in Ajax exists. This could have an impact on both the social and physical systems in place within the Town with particular consideration to:

- Beach closures;
- Drinking water; and
- Electricity generation.

Algae monitoring warrants an appropriate amount of management as climate change will potentially elevate this risk. It is recommended that the Town work closely with the Region to review the treatment systems currently in place as a mitigating measure to this potential scenario.

The potential warming of local waters and/or precipitation runoff could increase the intensity and prevalence of E.coli, otherwise known as the *Campylobacter jejuni* bacteria. The Durham Region Health Department (DRHD) monitors recreational waters within the region including the Town of Ajax and issues beach advisories when warranted. Following Canada's Guideline for Canadian Recreational Water Quality (2012), the DRHD issues advisories when the mean concentration of at least five water samples is at least 200E.coli/100 mL of water or when a single sample is at least 400 E.coli/100 mL of water.[28]

Food sources and the pathogens that compromise food safety can be impacted by climate change in a variety of ways. The prevalence of bacteria, viruses, pests, parasites, fungi and man-made chemical

[25] Source: "Human Health in a Changing Climate: A Canadian Assessment of Vulnerabilities and Adaptive Capacity." Health Canada, 2008: http://publications.gc.ca/collections/collection_2008/hc-sc/H128-1-08-528E.pdf
[26] USGCRP, 2016.
[27] Ibid.
[28] Source: Swim Guide: https://www.theswimguide.org/beach/36

contaminants are influenced by changes in ambient temperature and extreme events.[29] Similar to vector-borne diseases (**Section 3.1.3**), rising temperatures can lead to alterations in the geographical locations, seasonal occurrence and survivability of many known pathogens. Increased precipitation and subsequent flooding and runoff can lead to an increase in the levels of pathogens in food-related environments such as agriculture in that the water used for irrigation and harvesting of crops might be contaminated. Runoff from extreme events, like flooding, can contain heavy metals, pesticides, sewage, and hazardous waste among other contaminants, all of which have the potential to be harmful to human health and well-being.[30] Certain stages of food production most vulnerable to the effects of climate changes include the following factors:

- Livestock may be more likely to become ill when exposed to higher temperatures during transport increasing local risk of contamination;
- Deviations from temperature norms may decrease yields within agriculture or result in total crop failure;
- New food-borne pathogens may emerge as a result of climate-related changes in wild bird and animal population health;
- Increased demand in energy systems due to heat waves may result in blackouts or energy shortages leading to refrigeration failure and the spoiling and possible contamination of the contents within it.[31]

Exposure to ultraviolet waves

Increased greenhouse gas emissions in the atmosphere are impacting natural radiation processes. According to Natural Resources Canada this is slowing down the recovery of the ozone layer, which is resulting in reduced UV absorption in the atmosphere and therefore increasing potential human exposure. Certain adverse effects of UV ray exposure include skin cancers, alterations in cell structure, and suppression of the immune system leading to photokeratosis, conjunctivitis and cataracts.[32] Individuals who take certain medications such as some antibiotics, diuretics and contraceptives are predisposed to the harmful effects of UV rays as some medications can increase skin sensitivity.[33] Individuals who are at risk of increased exposure to the sun can mitigate the impacts of UV rays by taking necessary precautions including, wearing sunscreen, protective clothing, avoiding direct contact with the sun's rays when they are at their greatest intensity (midday hours) and by being cognisant of any medications that might increase their sensitivity.

[29] Ibid.
[30] Ibid.
[31] Health Canada, 2008.
[32] Ibid.
[33] Ibid.

Socio-economic impacts on community health and well-being

All impacts listed above have the potential to affect the mental health and well-being of individuals and a community in the form of anxiety, depression or even PTSD. Extreme weather events for example, can cause displacement, disruption to essential resources and social networks as well as injury and loss of life. These disasters have the ability to tax health care resources and systems due to the increase in individuals seeking medical attention.

Addressing future climate change scenarios should aim to reduce this vulnerability through the implementation of policies and programs geared towards demographics unequally affected by the severity and intensity of weather-related extremes. For the purposes of this study, there are a number of demographic groups that have been identified as priority populations and likely to be adversely and unequally affected by the projected increase of impacts associated with climate change; low income individuals, seniors, children, pregnant women, persons with pre-existing medical conditions or disabilities, individuals living locations of greater risk and recent immigrants. These demographic groups are known to the members of the Technical Working Groups for this project as Priority Populations and are discussed below (also see **Section 3.0** for definition of priority populations).

3.2 Low Income Individuals

It has been established through research that risk does not impact a community homogenously. Just as communities can be diverse, the potential for risk can also be variable. Those who are economically disadvantaged, including low-income families, the homeless, and those living alone may be predisposed to the adverse effects of a changing climate as less access to resources, support systems and income could impact an individual's capacity to prepare for, respond to and recover from climate based risks, in particular, those pertaining to one's health. Pre-existing stresses on livelihood could greatly impede one's ability to cope during or after a climate event.

In assessing the vulnerability of this group for the Town of Ajax, certain factors can be indicative of income levels. Labour force status is a possible indicator of income levels, which has a direct impact on risk (lower income, higher risk).

Table 3: Labour Force Status – Town of Ajax and the Province of Ontario

	Town of Ajax	%	Province of Ontario	%
In the labour force	67,415	*70%*	7,141,675	*65%*
Employed	61,865	*92%*	6,612,150	*93%*
Unemployed	5,550	*8%*	529,525	*7%*
Not in the labour force	28,130	*30%*	3,896,765	*35%*
Total	**95,540**	*100%*	**11,038,440**	*100%*

(Source: Statistics Canada 2016 Census)
Total - Population aged 15 years and over by Labour force status - 25% sample data

As shown in **Table 3,** the Town of Ajax has a slightly lower proportion (30%) of households that are not in the labour force compared to the province (35%). Although slightly lower than the provincial average, there is a significant portion of the population who are not participating in the labour force. **Table 4** supports this notion, as a similar amount of individuals are without employment income (26%), again slightly below the provincial average of 29% without employment income.

Table 4: Employment Income Status in 2015 – Town of Ajax and the Province of Ontario

	Town of Ajax		Province of Ontario	
Without Employment Income (2015)	24,475	26%	3,247,760	29%
With Employment Income (2015)	71,065	74%	7,790,680	71%
Total	95,540	100%	11,038,440	100%

(Source: Statistics Canada 2016 Census)
Total - Employment income groups in 2015 for the population aged 15 years and over in private households - 100% data

Those with lower financial security may lack the means to access cool places and air conditioning in the event of temperature increases, or may not have a vehicle with which to evacuate during a crisis. Similarly, a lower income can impede one's access to medication and proper health care, adequate food and drinking water, compounding their vulnerability in the event of food, water or vector-borne illnesses and diseases.

3.2.1 Homeless Persons

The homeless have increased potential to be impacted by the effects of climate changes many lack the resources, financial and otherwise with which to prepare for, respond to or recover from an extreme weather event. Emergency situations, such as floods that require evacuation would be challenging for many homeless persons without access to a vehicle or support system in place.

In the event of extreme temperatures, adequate shelter that provides relief from either extremely high or low temperatures may be difficult for these individuals to acquire as homelessness and poverty are interrelated. During prolonged heat events, public cooling centres are an available option to provide relief to the public and are available to all members of the community. Currently, Ajax does not have a cooling centre; however, as discussed in **Section 6.2.3** this is an initiative being considered by the Town to address heat related events in the future. Although this is a viable option, there are challenges in communicating the availability of such centres as is the case with emergency warnings in general and evacuation messaging.

In the Durham Region specifically, there are several facilities that shelter the homeless. There are a total of four shelters and 118 beds. Additionally there are 93 emergency beds, 90 beds for women fleeing family violence, 13 domiciliary beds, and 28 transitional housing beds in the Region altogether.[34] Although there are sheltering options available regionally for homeless persons, in the event of an emergency this may not be enough to shelter everyone. Other options for sheltering purposes should be explored by the Town in the event that the capacity of these existing facilities is exhausted. Alternative evacuation/reception centres are explored and discussed further in **Section 6.3.**

Figure 3 provides a spatial representation of schools and places of worship located throughout the Town of Ajax that could be used as shelters, including shelters for the homeless in during extreme weather events. Local faith-based community buildings can be resilience shelters, a concept that is explored further in **Section 6.3**. Our research suggests utilizing faith-based community buildings during emergencies is an approach that has been successfully implemented in other Ontario jurisdictions, including the City of Brampton.

Homeless individuals are particularly vulnerable to the health related impacts of climate change, having been exposed to the harsh conditions, mental and physical stressors of living on the streets, or other places not meant for human habitation. It has been reported that the severity of chronic disease among homeless populations in often greater than in general populations.[35] This can be attributed to poverty, lack of medical coverage and benefits, substance abuse, cognitive impairment and other factors.

Proactive disaster planning that is inclusive of the homeless is one way in which a municipality can mitigate the impacts of a disaster on homeless persons. Consideration with regard to the lack of resources, social networks, access to services and pre-existing physical, mental and emotional stressors associated with being homeless can help a community better prepare for the impacts of climate change on this demographic group. A number of measures can be incorporated into this type of disaster planning some of which might include:

- outreach warning communication strategies;
- specialist counseling services post-disaster;
- funding for recovery which support homeless people to establish new housing or supporting --- better options if they choose not to live in accommodation;
- training for service providers and emergency personnel on working with homeless people in disasters;
- training for agencies to develop disaster plans for themselves; and

[34] Source: "Population Facts." Homeless Hub: http://homelesshub.ca/community-profiles/ontario/durham-region
[35] Source: "Health of the Homeless and Climate Change." Journal of Urban Health, 2009: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2704276/

- education and programming for homeless persons on what to expect in the event of a disaster, and where they can access assistance.[36]

3.3 Seniors

Seniors or individuals older than 65 as a group are at a higher risk of health related impacts of climate change due to a number of factors. Older individuals are more likely to have medical conditions and ailments prior to a weather related event and after which their conditions could be exacerbated. Some may face physical limitations, live alone, experience chronic illness or perhaps may be confined to a bed at home, medical facility or collective dwelling. A portion of these individuals may experience social isolation or lack a support system or may be living off of a reduced income. Those at risk may lack the ability to cope or adapt to climate variability exacerbating pre-existing health concerns and illnesses. Their health may deteriorate due to new illnesses arising from exposure to air, water or food related diseases and extreme weather events could delay access to medications or other required treatments.

Canada's aging population has been recognized as one of the most significant demographic trends in the nation. Based on preliminary post-censal estimates from Statistics Canada, on July 1, 2015, for the first time ever, there were more Canadians over the age of 65 (16.1% of the population) than there were children aged 0 to 14 (16.0%). According to **Table 5**, 11% of the Town's population is 65 years of age or older, below the provincial total of 16.7%. For future consideration, 7% of the population in Ajax is aged 50 to 59, with an additional 5% aged 60 to 64, reflecting a population that will soon be classified as seniors.

[36]Source: "Disaster Resilience: Can the Homeless Afford it?" Australian Journal of Emergency Management, 2014: https://www.researchgate.net/publication/264384426_Disaster_Resilience_Can_the_Homeless_Afford_It

Table 5: Population by Broad Age Group for the Town of Ajax and the Province of Ontario

	Town of Ajax		Province of Ontario	
Broad Age Group	Population	% Total	Population	% Total
0 to 14 years	23,660	19.8	2,207,970	16.4
15 to 64 years	82,890	69.3	8,988,865	66.8
65 years and over	13,135	11	2,251,655	16.7
85 years and over	1,265	1.1	301,075	2.2
Average age of the population	37.3	-	41	-
Median age of the population	37.4	-	41.3	-
Total	**119,675**	**100%**	**13,448,495**	**100%**

(Source: Statistics Canada 2016 Census)
Total - Distribution (%) of the population by broad age groups - 100% data

3.4 Children

Due to their dependence on others, children are considered a priority population group. They lack the physical structure and cognitive ability to make informed sound decisions about their well-being. Children may be more susceptible to the health risks that arise as a result of extreme weather events, temperature changes and precipitation. Physiologically, their bodies may be more sensitive to sudden and extreme changes in temperature and the prevalence of food and water borne illness could challenge an underdeveloped immune system.

Table 5 indicates that the demographic between the ages of 0 to 14 represents 19.8% of the Town's total population. This is greater than that of the province at 16.4%, presenting a 3.4% difference. Special consideration should be given to this demographic in the development of climate change planning and programming.

While youth and seniors are considered priority populations when it comes to climate based risk, the general adult population makes up a high proportion of the population (i.e. ages 15 to 64 years being 69.3% of the population in Ajax). This group should still be considered when planning public education and prevention programming.

3.5 Pregnant Women

Women who are pregnant are more likely to experience an increase in risk during climate based events. In the event of a climatic event or more specifically evacuation due to an emergency, carrying mothers may not have access to the medication and prenatal vitamins essential to their own health and the well-being of their child. In some instances, they may have to deliver without proper medical attention. In addition, there is the possibility for premature deliveries and infant mortality due to an increase in risk of climate related diseases. Currently, there is no definitive data source for this demographic profile.

3.6 Individuals with Pre-existing Medical Conditions

Pre-existing medical conditions can impact the vulnerability of an individual to the risks associated with climate change. These pre-existing conditions could include chronic health conditions, limited mobility, and terminal illness. The intensity, severity and frequency of stressors like weather events, temperature and precipitation could have negative impacts on an individual with physical or cognitive limitations. For those who are reliant on specific medications, any disruption to their intake could prove fatal or have negative health effects.. In the event of a climate related emergency, medical attention and the availability of medications pertinent to one's health may not be readily available. Some individuals rely on specialized equipment, breathing apparatuses or other devices that could make evacuation challenging; and in some cases, evacuation of these individuals may not be an option.

As discussed earlier, the stressors associated with climate change can have a number of negative impacts on a person's health due to diminished air quality, the rise of food and water-borne illnesses and the manifestation of vector-borne diseases. An already weakened immune function would make a person more susceptible to contracting these types of illnesses.

Mental illness can impact a person's level of sensitivity to a hazard, as well as an ability to cope with the spectrum of mental illness is broad, and can seriously impede how an individual responds to a hazard, as well as one's capacity to adapt. Some individuals may not possess strong social connections within their community or lack a social support networks.

Those with drug and alcohol dependencies could also be classified as having pre-existing medical conditions. Addiction may impair an individual's ability to make informed decisions during an emergency, relating to shelter, aid or safety.

3.7 Individuals with Disabilities

Similar to those with pre-existing medical conditions, individuals with a disability may experience functional limitations impeding their ability to adapt to a climatic event. These limitations can include sensory impairments, mobility issues or cognitive and/or physical impairment. Evacuation can be challenging if an individual relies on highly specialized care or attention such as a constant supply of oxygen or if there is a reliance on a mobility device. Official communications pertaining to risk and

emergency warnings and information may not necessarily reach an individual who has a sensory or cognitive impairment. Consideration should be made to developing emergency response procedures that consider the needs and circumstances of those with disabilities, be it a physical or cognitive limitation.

3.8 Individuals Living in Certain Locations

The Ministry of Natural Resources (MNR) defines flooding as an overflow of water associated with a lake, river or stream that threatens the safety, welfare of people and/or damage to public and/or private property. Buildings affected by ensuing water damage can lead to significant health conditions for the occupants within them. Floods may be caused by natural phenomena (e.g. weather), structural failure (e.g. dams), or human interference (e.g. stream diversion).[37] Individuals who live or work within or in close proximity to waterways, floodplains or in areas where the land is sunken or depressed below surrounding land would likely face a higher risk to the outcomes of a precipitation event or overland flooding due to structural failures. Riverine and overland floodplain mapping, a flood specific emergency response plan and historical data can assist response officials in identifying which areas are the most vulnerable.

Where a person is located can have an impact on their exposure and sensitivity to rising temperatures. Urban dwellers are more likely to be impacted by the effects of increased temperatures due to the heat island effect (also see **Section 3.1.1)**. The Environmental Protection Agency describes this as a phenomenon whereby the sun heats the dry, exposed surfaces of concrete and pavement which often lack shade and moisture.[38] This results in a higher temperature within urban areas than their rural counterparts. Establishing cooling centres and splash pads within built up urban areas can be an effective way of providing relief from rising temperatures to priority individuals who do not have access to air conditioning (also see **Section 6.2.3)**.

3.9 Recent Immigrants

Cultural diversity and ethnic background can be factors for emergency service providers to consider in developing and delivering programs related to climate change and when responding to climate related emergencies. Communication barriers, in terms of language and the ability to read written material, can have an impact of the success of these programs and might present barriers when communicating in response situations. There may also be familiarity challenges related to evacuation procedures, local

[37] Source: "Guideline for the Development of a Municipal Flood Emergency Plan." Ontario Ministry of Community Safety and Correctional Services. Last Modified 25 May, 2016: https://www.emergencymanagementontario.ca/english/emcommunity/program_resources/hazardbasedplanning/flood_guideline.html

[38] Source: "Learn About Heat Islands." United States Environmental Protection Agency: https://www.epa.gov/heat-islands/learn-about-heat-islands

safety protocols and with local climate variability within recent immigrant populations. In addition, a high proportion of immigrants could demonstrate a higher risk due to a population that has a potential for: lower income; lack of a strong social network; and/or experience possible language barriers, making it difficult for them to understand government-issued warnings about health related concerns.

Table 6 presents the overall immigrant status of the population in the Town of Ajax and the Province of Ontario. The City has a higher proportion of immigrants (39%) compared to the Province as a whole (30%). The Town of Ajax has 3% of the total population that is defined as recent immigrants (2011-2016) compared to 4% in the Province. This suggests that in comparison to the Province, there is a slightly lower proportion of at-risk immigrants. **Table 7** indicates the percentage of the population that possess knowledge of the official language. Only 0.2% of the total population of the Town of Ajax does not possess knowledge of either English or French. Again, this is lower when compared to the Province at 2% for Ajax.

Table 6: Immigration Status – Town of Ajax and the Province of Ontario

	Town of Ajax	%	Province of Ontario	%
Non-immigrants	72,310	61%	9,188,815	70%
Immigrants	46,335	39%	3,852,145	30%
Before 1981	11,240	9%	1,077,745	8%
1981 to 1990	7,520	6%	513,995	4%
1991 to 2000	12,255	10%	834,510	6%
2001 to 2010	11,735	10%	953,730	7%
2001 to 2005	6,800	6%	490,560	4%
2006 to 2010	4,930	4%	463,170	4%
2011 to 2016	3,585	3%	472,170	4%
Non-permanent residents	530	0.004%	201,200	2%
Total	119,180	100%	13,242,160	100%

(Source: Statistics Canada 2016 Census)
Total - Immigrant status and period of immigration for the population in private households - 25% sample data

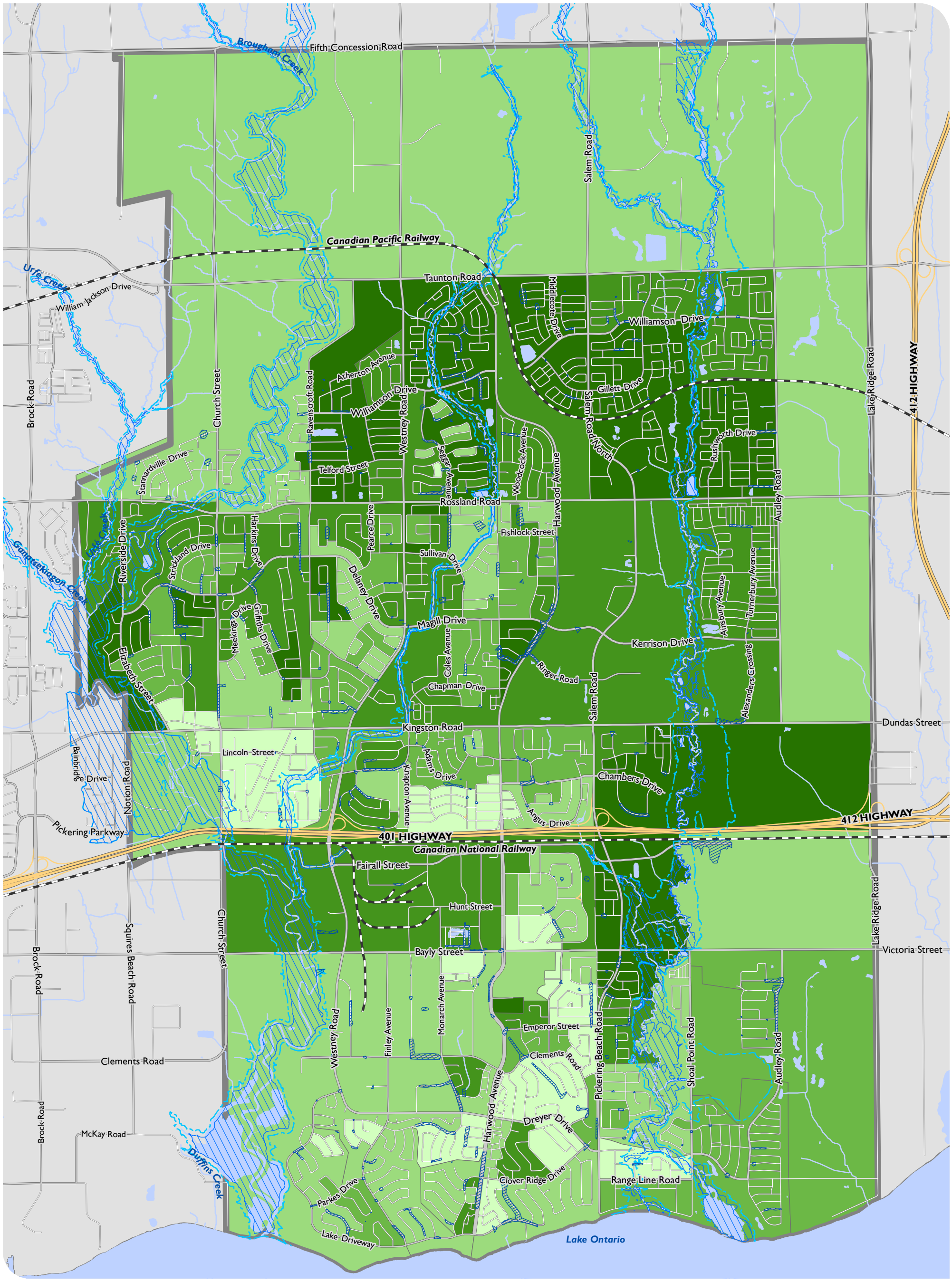
Table 7: Knowledge of Official Languages – Town of Ajax and the Province of Ontario

Language	Town of Ajax		Ontario	
	Total	% Total	Total	% Total
Total population (non-institutional)	**119,215**	-	**13,312,865**	-
English Only	108,185	91%	11,455,500	86%
French Only	110	0.5%	40,040	0.3%
English and French	9,115	8%	1,490,390	11%
Neither English nor French	1,800	1.5%	326,935	2.7%

(Source: Statistics Canada 2016 Census)
Total - Knowledge of official languages for the total population excluding institutional residents - 100% data

The spatial distribution of recent immigration in Ajax is represented in **Figure 2**. Higher concentrations of recent immigration populations can be seen in Town's eastern corridor, in close proximity to the 401/412 highway, as well as in the residential land space between Taunton Road and Rossland Road. The linguistic and cultural needs that may exist in these areas should be considered when developing and implementing emergency preparedness initiatives. There are a number of strategies emergency planning professionals can implement to better prepare immigrant communities for an emergency situation or disaster. These strategies include:

1. The provision of emergency assistance in multiple languages (i.e. multi-lingual printed materials, and media messaging, bilingual emergency professionals);
2. The development of relationships with ethnic or cultural organizations to expand the depth of public education and to distribute emergency materials; and
3. Involving cultural organizations in the disaster planning process.



TOWN OF AJAX
COMMUNITY CLIMATE STUDY

RECENT IMMIGRATION
FIGURE 2

100 Year Climate Change Overland Flooding Extent
100 Year Climate Change Riverine Flooding
Railway
Regional Floodline

Recent Immigration (Last 5 Years) % of Total Population

- 0.07 - 0.20
- 0.21 - 0.28
- 0.29 - 0.35
- 0.36 - 0.42
- 0.43 - 0.60

DILLON CONSULTING

MAP DRAWING INFORMATION:
DATA PROVIDED BY AJAX

MAP CREATED BY: GM
MAP CHECKED BY:
MAP PROJECTION: NAD 1983 UTM Zone 17N

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PROJECT: 187286 STATUS: DRAFT DATE: 2018-10-11

FILE LOCATION: I:\GIS\187286 - Town of Ajax Community Climate Study\mxd\Emergency Response\Figure 2 Recent Immigration.mxd

3.10 Occupational Groups

Workers in general are often among the first individuals to experience the adverse effects of climate change and the various stressors it imposes. Due to the nature of some professions, both indoor and outdoor workers can be subjected to climate events and their impacts at greater intensities than other individuals. These impacts may exacerbate existing occupational hazards, while also presenting new challenges and risks to worker health and safety. Various occupational groups particularly at risk include but are not limited to:

- Agricultural and animal husbandry workers;
- Certain indoor workers, in particular those working in facilities that are not climate controlled;
- Construction workers;
- Emergency responders;
- Health care professionals;
- Landscapers;
- Municipal service workers;
- Other outdoor workers; and
- Transportation workers.

Outdoor workers are particularly at risk to the effects of climate change as they are often required to work for longer periods and some at a greater physical intensity than others, thereby increasing their exposure to extreme temperatures, poor air quality, ultraviolet radiation, and in some instances, vector-borne diseases and illnesses. As temperatures continue to rise, especially in the summer months, the potential for heat stroke and other heat-related illnesses will increase. Higher temperatures pose a number of risk factors. Subjugation to high ambient temperatures, longer periods of work, physically demanding work or a combination of these can consequently lead to heat stroke, heat exhaustion, a reduction in cognitive functioning, dehydration, fatigue and injury, compromising the worker's safety.[39] Some occupational groups, such as first responders wear, personal protective equipment or gear that can further contribute to heat stress. Heat-related illnesses are compounded with the presence of ultraviolet radiation placing the health and well-being of outdoor workers at an even greater risk.

The urban heat island effect (described in **Section 3.1.1**) which occurs in city-centres exacerbates extreme temperatures and humidex levels placing outside workers at a greater risk of heat exposure related conditions. Those occupations that operate in concrete, built-up urban centres are more likely to be exposed to these stressors exacerbated by physical labour that can lead to exertion. The Durham Community Climate Adaptation Plan has established an objective to reduce ambient summer

[39] (IRSST), 2013.

temperatures in urban areas in order to reduce heat stress. Some of the measures proposed to accomplish this goal include increasing urban tree coverage, introducing light coloured pavement and buildings and reflective roofing to the urban landscape and improving thermal performance of buildings overall.

Conversely, the occurrence of extremely cold temperatures presents a number of risks to outdoor workers as well. For example, municipal and regional staff are typically tasked to respond to tree damage or snow removal, in some instances before the conditions of extreme weather dissipate, presenting a potential for higher risk for these individuals who are responding to damages during an event. Trees can conduct electricity and emergency or municipal workers responsible for clearing trees that have fallen due to weather events should take caution. Electrical shock can occur when tree limbs are in direct contact to power lines or even very near to them. For electrical hazard safety best practices for emergency workers, please refer to *Electrical Safety Handbook for Emergency Responders.*[40]

Poor air quality is another stressor to which outdoor workers might be exposed. Alterations in weather patterns have been known to increase the frequency and intensity of air pollution the effects of which can vary depending on the concentration of air pollutants in a given area, the duration to which an individual is exposed and the person respiratory conditions of those affected.[41] Workers and the public in general with pre-existing medical conditions related to respiratory or cardiovascular complications are particularly at risk to fluctuation sin air quality. For example, higher levels of carbon dioxide is associated with earlier flowering periods in plants, resulting in a longer season of pollen production which would consequently aggravate allergic reactions in those predisposed to such conditions.[42]

Extreme weather events and natural disasters increase the demand on community response agencies to provide emergency responders who are equally exposed to the dangerous conditions created by such events. The impacts of climate change could impede the ability and capacity of first responders to effectively respond to an emergency, potentially placing their own individual health at risk. Fire, Police and EMS experience the effects of climate change as they are exposed to illness, temperature extremes, and unsafe conditions resulting from extreme weather events. An increase in the severity and frequency of climate change related events presents new challenges for first responders, which can lead to higher risk of injury, disease exposure and mental stress. Occupational stress injuries and Post-Traumatic Stress Disorder (PTSD) resulting from operational duties while serving a community during an emergency can also arise with prolonged exposure to stressful or traumatic situations.

[40] "Electrical Safety Handbook for Emergency Responders". Public Services Health and Safety Association, Hydro One Networks Inc., Electrical Safety Authority, Office of the Fire Marshal, 2013: https://www.pshsa.ca/products/electrical-safety-handbook-for-emergency-responders/
[41] Ibid.
[42] Ibid.

With proper training, procedures, safety measures etc., the adaptive capacity of these first responders could be strengthened. A recent initiative undertaken by the Ministry of Labour requires employers of those workers covered under Post Traumatic Stress Disorder presumptive legislation to prepare and provide the Minister with PTSD prevention plans. Those employees covered under this legislation include:

- Police, including First Nations constables, and chiefs of police;
- Firefighters (including part-time and volunteer firefighters), including those who are employed or who volunteer to provide fire protection services on a reserve; fire investigators, and fire chiefs;
- Paramedics and emergency medical attendants, and ambulance service managers;
- Workers involved in dispatching emergency services, including workers who play a role in the chain of communications which lead up to the dispatch for ambulance services, firefighters and police;
- Correctional officers/youth services workers (including managers) and workers who provide direct health care services in adult institutional corrections and secure youth justice facilities; and
- Members of emergency response teams dispatched by a communications officer.

Indoor workers of certain occupational groups might also be affected. Depending on present working conditions and the quality of the workplace, some may face extreme temperatures due to lack of adequate air conditioning or heat, while others such as factory workers for example might be at an increased risk of air pollution exposure due to a lack in proper ventilation systems. Healthcare workers primarily work indoors as well. As discussed in **Section 3.1.3**, higher temperatures and increased precipitation are precursors for vector-borne diseases and illness due to alterations in incubation rates and prolonged transmission seasons. In areas where vector-borne related illnesses have arisen, healthcare workers are at a higher risk of contracting those illnesses as they are most likely to be exposed to them.

Additionally, extreme weather events may impact the safety and well-being of workers during their daily commute to and from the workplace. Downed trees and flooding can prevent occupational groups including emergency workers from reaching their destination or place of employment affecting businesses within the area and the overall economic wellbeing of the community. Commuter populations represent a significant portion of the Town's labour force as it is centrally located within a transportation corridor linking residents to employment opportunities through the Durham Region by way of Highway 401. One way to measure this population shift is based on traffic counts. The Transportation Tomorrow Survey (TTS) reports on topics such as how many trips are made to ad from Ajax. The most recent TTS report (2016) indicates that in a 24-hour period, approximately 235,300 trips

are made by the residents of the Town, 69% of which traveled by driving a vehicle. Similarly, 194,300 trips were made to Ajax by residents of the TTS area in a 24-hour period.[43]

3.11 Priority Population Mapping

A spatial representation of social vulnerability as it relates to the Town's priority populations is displayed in **Figure 3**. This map is a representation of the outcomes of a previous research project conducted by NASA DEVELOP, a branch of NASA's Applied Sciences Program. The layers used in **Figure 3** represent the Dissemination Areas in Ajax with priority populations. Priority in the NASA study was based on the following five criteria:

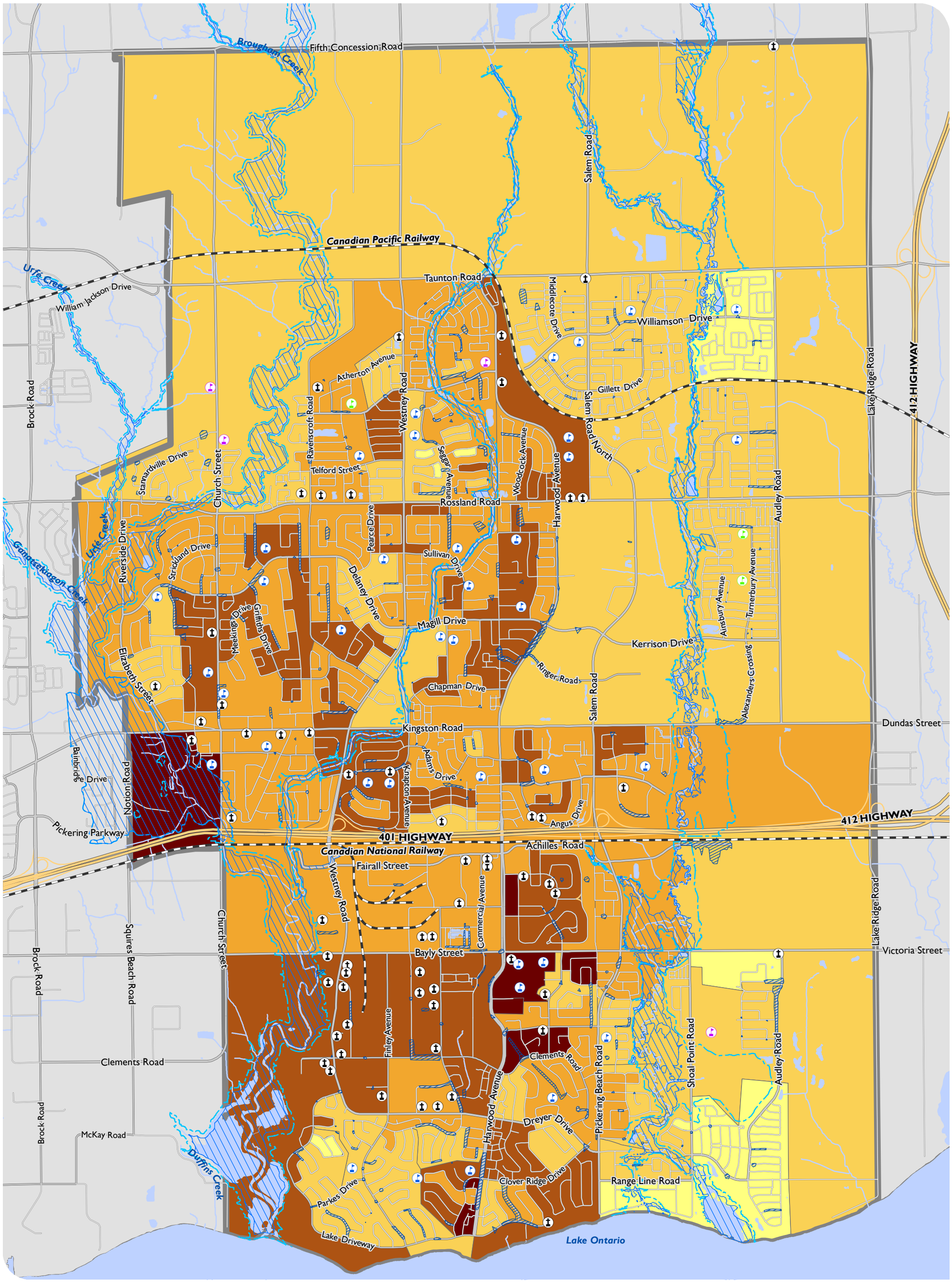
1. Number of immigrants in the last five years;
2. Median household income;
3. Number of senior citizens;
4. Number of people without college degrees;
5. Number of people that are unemployed; and
6. Number of people living alone.

A visual analysis of **Figure 3** indicates that the populations of the highest priority reside in the following neighbourhoods:

1. Area west of Harwood Avenue and north of Lake Driveway west;
2. Neighbourhoods south of Bayly Street and east of Harwood Avenue south; and
3. Area north of the 401 highway and east of Notion road.

When evaluating potential evacuation centres, reception and cooling centres as well as splash pads (see **Section 6**), the Town may choose to consider including criterion relating to the proximity to locations with a large amount of priority populations in an effort to accommodate them.

[43] Transportation Tomorrow Survey, 2016: http://dmg.utoronto.ca/pdf/tts/2016/2016TTS_Summaries_Durham_Wards.pdf



TOWN OF AJAX
COMMUNITY CLIMATE STUDY

PRIORITY POPULATION WITH POTENTIAL RECEPTION/ EVACUATION CENTRES
FIGURE 3

- Existing School
- Future School
- School Under Construction
- Place of Worship
- 100 Year Climate Change Overland Flooding Extent
- 100 Year Climate Change Riverine Flooding
- Railway
- Regional Floodline

Total Vulnerability
- Low
- Moderately Low
- Moderate
- Moderately High
- High

DILLON CONSULTING

MAP DRAWING INFORMATION:
DATA PROVIDED BY AJAX

MAP CREATED BY: GM
MAP CHECKED BY:
MAP PROJECTION: NAD 1983 UTM Zone 17N

1:32,000
0 250 500 1,000 m

PROJECT: 187286 STATUS: DRAFT DATE: 2018-10-11

FILE LOCATION: I:\GIS\187286 - Town of Ajax Community Climate Study\mxd\Emergency Response\Figure 3 Priority Population with Potential Reception_Evacuation Centres.mxd

3.12 Priority Population Registries within Durham Region

Through the Technical Working Groups, and a review of Durham Region's Climate Adaptation Plan (2016), two registries identifying priority populations were discussed. The first, is intended to be included as part of the Extreme Weather Alert and Response (EWAR) System. The EWAR has been designed "to create a mechanism to alert Durham residents (especially priority populations and the agencies that serve them) about impending extreme weather events (e.g., high temperatures and humidex readings, ice storms, flooding, tornadoes, and poor air quality) and to provide, where possible, access to response systems to protect people. These responses could include opening of cooling/warming centres, free public swims, outreach to priority populations, checking on seniors and people with health issues, etc."

The second registry is maintained by the Durham Regional Police Service and focusses on people with cognitive challenges who may wander.

The Ajax Fire and Emergency Services Department may also have this data due to legislated requirements for some building owners to prepare a Fire Safety Plan which includes evacuation procedures for individuals who may require assistance. Through conversations with members of the Technical Working Groups, it was learned that some of the information collected by the agencies operating these registries may include personal data, therefore restricting the agencies from sharing information. Further discussion regarding developing a registry identifying prioritized populations may be a consideration, however it would be recommended that advice be obtained from the Town's legal department to ensure information is collected and retained in accordance with the Municipal Freedom of Information and Protection of Privacy Act.

3.13 Summary of Demographic Groups at Risk

A summary of the demographic groups at risk considered in this study are included in **Table 8** below.

Table 8: Demographic Group and Climate Health Impacts Summary Table

Potential Health Impacts	Population Impacted*
Temperature Related Morbidity and Mortality	• Individuals Living With Low Income; • The Homeless; • Seniors; • Children; • Pregnant Women; • Those With Pre-Existing Medical Conditions (Including Addiction); • Persons With Disabilities; • Individuals Living In Certain Areas; • Recent Immigrants; And
Weather Related Hazards	
Vector-borne Diseases	
Poor Air Quality	
Food and Water-borne Illnesses Exposure to Ultraviolet Waves	
Socioeconomic Impacts on Community Health and Well-Being	

Potential Health Impacts	Population Impacted*
	• At Risk Workers (Including First Responders, Outdoor Workers, Indoor Workers Working In Facilities Without Climate Control Features).
**Source: All priority populations could potentially be impacted by any number of the corresponding climate change health impacts*	

These groups of people are considered to be at higher risk of being impacted by the effects of climate change. Efforts should be made to consider the needs and potential barriers that may exist for the demographic groups discussed. This includes ensuring programming and emergency response activities are provided in a manner that is inclusive of the diversity represented within the Town, including the priority population.

4.0 Local Partners and Resources

In the case of an emergency or severe incident, local partners and resources are critical to effective and complete municipal emergency response. The location of local partners and resources has not been spatially represented as part of this study. Local partners may include:

- Red Cross;
- St. John's Ambulance;
- Salvation Army;
- Durham Catholic District School Board;
- Durham District School Board;
- Durham Region Health Department;
- Central Lake Ontario Conservation Authority;
- Toronto and Region Conservation Authority; and
- Local service clubs (e.g., Optimist, Rotary, etc.).

It is recognized that the Town is already involved in collaborative efforts with many of these local partners. A next step may involve developing a database that inventories both human and physical resources that could be made available in the event of an emergency. This would not necessarily need to be limited to response to climate change events and could be developed to be drawn on as part of the Emergency Response Plan. The number of persons who could be mobilized to assist in the event of an emergency and details regarding the type of resources available could be included. Further, there may be opportunity to provide training to these individuals in advance of an event ensuring an increased level of preparedness should their assistance be required during an emergency.

For the purposes of this project, the following documents listed in **Table 9** were reviewed and will be discussed in the section that follows:

Table 9: Reviewed Documents

Document Title	Author	Date
Emergency Response Plan	Town of Ajax	November 2017
Flood Contingency Plan	Toronto and Region Conversation Authority	2017
Towards Resilience: Durham Community Adaption Plan	Durham Region	2016
Central Lake Ontario Conservation Watershed Flood-Risk Assessment	Central Lake Ontario Conversation	April 2017
Work Instruction- Building Profile and Information Sheet	Town of Ajax	April 19, 2016
Durham Region Emergency Master Plan	Durham Region	February 2018

4.1 Emergency Response Plan

The importance of an Emergency Response Plan is to ensure that there is a coordinated, controlled and effective response to emergencies with the objective of minimizing impacts to safety, health and welfare of residents in a municipality. The scope of these emergencies can vary temporally, lasting a few hours to several days or longer.

In 2017, the Office of the Fire Marshal and Emergency Management circulated the *Emergency Management and Civil Protection Act* Compliance Guide for Municipalities. The guide provides information to assist municipalities in achieving compliance with the EMCPA.

To verify compliance with the EMCPA, municipalities are required to annually review and submit the following documentation:

- Emergency Response Plan (ERP);
- Proof of training;
- Proof of exercises;
- Evidence of public education program;
- Municipal Hazard Identification Risk Assessment (HIRA);
- Critical Infrastructure (CI) List; and
- Emergency Management Program By-law.

A municipality's compliance under the EMCPA and Ontario Regulation 380/04, can now be reported through online submission to the OFMEM. Documents that support annual compliance can be uploaded to a new, secure submission tool. Submitted data is used by the OFMEM to identify provincial trends as well as a method of informing programming. Compliance is monitored by the OFMEM.

The Town's Emergency Response Plan ("Plan" or "ERP") is dated November 20, 2017 and was passed by by-law 69-2017, in conformance with the EMCPA requirement to have a municipal emergency plan. The Plan and non-sensitive annexes are available to the public on the Town's municipal website. According to the ERP, the Plan has been approved by Council and filed with the Office of the Fire Marshal and Emergency Management.

The Fire Chief/Deputy Fire Chief or Emergency Information Officer is listed as the Community Spokesperson responsible for:

- Providing Council with status updates in the event of an emergency and sharing emergency public information;
- Liaising with elected officials at the local, provincial and federal levels of government;
- Giving media interviews, and attending press conferences; and
- Redirecting inquiries regarding the decisions of the Municipal Emergency Control Group (MECG) and the emergency to the Emergency Operations Centre (EOC) Director.

The Plan provides the option of the Emergency Information Officer (EIO) fulfilling this role should the Fire Chief and/or Deputy Fire Chief be occupied with the emergency, or otherwise unavailable. Having three potential persons responsible for these tasks has advantages, primarily, allowing the Fire Chief and/or Deputy Fire Chief to remain focused on operational emergency tasks rather than on communication with elected officials, the public and the media. This depth also allows for individuals to be spelled off by each other should an emergency event span over multiple operational cycles. As with all individuals who have responsibilities under the ERP, It is crucial that the three individuals who hold the position of Fire Chief, Deputy Fire Chief and Emergency Information Officer have all received training and hold the competencies required to act in this capacity.

Section 8 of the ERP discussed Requests for Assistance, including Mutual Aid for fire service emergencies, and Mutual Assistance when there is a need for additional personnel, services, equipment and materials during an emergency. The Plan specifies that all requests for assistance are to be reviewed and approved by the MECG. Typically, the Fire Chief and/or his/her designate(s) are granted the authority a mutual aid by-law to activate mutual aid through the fire coordinator using his/her discretion and without prior approval. Anecdotal evidence suggests that this is also the process followed by Ajax Fire and Emergency Services. Further clarity could be provided in future versions to avoid any ambiguity on this point.

During Workshop #2, it was confirmed that the Town participates in the Durham Region Mutual Aid Plan.

It is recognized that the Plan was prepared to provide key individuals with an overview of their individual as well as collective responsibilities and the procedures with which to respond to any type of emergency. Given the Town's focus on climate change, it is recommended that the ERP be reviewed through the lens of climate change.

4.1.1 Human Resources Plan (Annex A)

Annex A to the ERP is entitled *Human Resources Plan*. The Human Resources Plan references the HR Services Department's mission to "provide a recruiting service for volunteers to meet the needs of the "Municipal EMO" but neither the Emergency Response Plan nor the Human Resources Plan defines the term Municipal EMO. It is assumed this Human Resources Plan is referring to the Municipal Emergency Control Group (MECG) or the Municipal Emergency Operations Centre (EOC). Consistent use of terms throughout the Emergency Response Plan and annexes would relieve any uncertainty in this regard.

The Notification and Staffing Procedure that forms part of Annex A speaks to next of kin being notified by staff involved in the Emergency Operations Centre "as soon as feasible" by each staff member. While this may be possible in many cases, there may also be times during operational cycles that all staff will be occupied for long periods of time with tasks associated to the emergency. An alternative method of

communicating with the family of affected staff such as a fan out system, text or email notification would be recommended.

4.1.2 Flood Emergency Preparedness Plan (Annex B)

Annex B to the Emergency Response Plan is a document entitled *Flood Emergency Preparedness Plan-Carruthers Creek Flood Management & Analysis Municipal Class EA*. This Plan was prepared by Cole Engineering and is dated May 2012. The introduction of the Flood Emergency Preparedness Plan specifies that the document "is intended to be used as a tool to support and coordinate the existing Town of Ajax Emergency Response Plan (2007) and the TRCA Flood Contingency Plan (2009). As previously mentioned, the current Emergency Response Plan is dated 2017.

The Flood Emergency Preparedness Plan provides processes and procedures including detailed monitoring locations, emergency access routes and inspection areas to be utilized in the event of an emergency due to high water levels of the Carruthers Creek. The Plan does not however include other waterways including Duffins Creek, which also runs through Ajax. The emergency access route information provided as part of the Flood Emergency Preparedness Plan is therefore also limited to the portion of the Town included in the Carruthers Creek Flood Management area. While the TRCA Flood Contingency Plan is referenced, it is not included in the larger Emergency Response Plan. Preparing a more comprehensive Flood Emergency Preparedness Plan or updating the current Emergency Preparedness Plan with copies of all relevant flood plans may be a future consideration to ensure the entire Town has been included in preparedness efforts.

4.1.3 Hazard Index Risk Assessment (Annex C)

Annex C to the Emergency Response Plan is the Town of Ajax's Hazard Index Risk Assessment (HIRA). The Office of the Fire Marshal and Emergency Management provides the following explanation of a HIRA:

"A Hazard Identification and Risk Assessment (HIRA) assists emergency managers in answering these questions. It is a systematic risk assessment tool that can be used to assess the risks of various hazards.

There are three reasons why a HIRA is useful to the emergency management profession:

- It helps emergency management professionals prepare for the worst and/or most likely risks;
- Allows for the creation of exercises, training programs, and plans based on the most likely scenarios; and
- Saves time and resources by isolating hazards that cannot occur in the designated area."[44]

[44] Source: Hazard Identification and Risk Assessment for the Province of Ontario, 2016.

The Town's HIRA assigns consequence rates and probability factors to for thirty five hazards, based on the potential for significant fatalities, injuries and evacuations, property damage, impact to critical infrastructure, the environment, the economy as well as the population's psychosocial wellbeing. In keeping with industry best practices, the Town has identified natural, technological and human caused hazards. For the purposes of this project, only natural hazards were considered. Natural hazards have been defined by the Office of the Fire Marshal and Emergency Management as "those hazards which are caused by forces of nature (sometimes referred to as 'Acts of God'). Human activity may trigger or worsen the hazard; (for example deforestation may increase the risk of a landslide) but the hazard ultimately is viewed as a force of nature."[45]

The following hazards are listed almost certain to occur:

- Lightning
- Heavy Rain
- Windstorm
- Extreme Temperatures
- Fog
- Snowstorm/Blizzard
- Freezing Rain
- Explosion/Fire
- Transportation Emergency
- Special Event

The following hazards are listed as likely to occur:

- Hail
- Flood
- Energy Emergency/Power Outage

The following hazards are listed as probable:

- Tornado
- Health Epidemic/Pandemic
- Hazardous Material Incident
- Critical Infrastructure Failure
- Cyber Attack

[45] Ibid.

The following hazards are considered unlikely to occur:

- Hurricane
- Agriculture/Food Emergency
- Dam Failure
- Drought Low Water
- Earthquake
- Forest Fire/Wildfire
- Geomagnetic Storm
- Oil/Natural Gas Emergency

The following hazards are considered very unlikely to occur:

- Building Collapse
- Nuclear Emergency
- Civil Disorder
- Radiological emergency

The following hazards are considered rare:

- War and International Emergency
- Terrorism/CBRNE
- Sabotage
- Natural Space Object Crash
- Landslide
- Human-made Space Object Crash
- Drinking Water Emergency

It is recommended that the Town continue to review their Hazard Index Risk Assessment on an annual basis as per legislative requirements.

4.1.4 Critical Infrastructure (Annex D)

The Office of the Fire Marshal and Emergency Management (OFMEM) defines critical infrastructure as "interdependent, interactive, interconnected networks of institutions, services, systems and processes that meet vital human needs, sustain the economy, protect public health, safety and security, and maintain continuity of and confidence in government." The OFMEM also sets out nine critical infrastructure sectors, namely: continuity of government, electricity, financial institutions, food and water, health, oil and natural gas, public safety and security, telecommunications and transportation networks. These nine sectors have further been recognized by the Ministry of Energy and Emergency Management Ontario, all of which are captured in **Table 10** below.

Table 10: Critical Infrastructure Sectors

Critical Infrastructure Sector	Sector components
Continuity of Government	municipal, provincial and federal governments
Electricity	nuclear, hydroelectric and fossil power generation; electricity transmission and distribution
Financial Institutions	Bank of Canada, banks and trust companies, credit unions, caisses populaires, Province of Ontario Savings Office, inter-institution computer systems, insurance companies, mutual fund companies, stock exchanges
Food and Water	water treatment, water storage, water monitoring, water distribution, waste water and sewage treatment, food production and harvesting, food processing and distribution, food inspection and monitoring
Health	hospitals, ambulance services, pharmaceuticals, blood services, and long-term care facilities
Oil and Natural Gas	oil refineries, distribution and retail operations; natural gas distribution
Public Safety and Security	firefighting, police and emergency medical services, emergency operations and evacuation centres, Centre of Forensic Sciences, Office of the Chief Coroner, military facilities, correctional facilities, search and rescue, flood and erosion control, pollution monitoring and public alerting, weather forecasting and public alerting
Telecommunications	9-1-1 communications, telephones, wireless telephones, pagers, television stations, radio stations, internet)
Transportation	highways and roads, snow removal services, rail-ways, public transit, airports, aviation communication and navigation, port facilities, canals and shipping locks, movable bridge systems, ferries, marine communication and navigation, border controls[46]

Annex D of the Town's ERP provides a list of those assets it considers to be critical infrastructure. The financial institutions sector is missing from the list. While a gas pipeline is included, the retail fuel suppliers are not. Anecdotally it was discovered that the Town has a contract with the fuel supplier to ensure fuel supply for three days of operations, in keeping with industry best practices. That contract was not reviewed as part of this study. Please see **Section 6.4.1** for further discussion about gas station zoning and fuel concerns. The Town provided the following information regarding generator location, capacity and fuel tank size:

- Fire Station 1 – 17 kW generator with 910 L tank
- Fire Station 2 – 100 kW generator with 750 L tank
- Fire Headquarters – 200 kW generator with 1485 L tank

[46] 10. Source: "Ontario Government Emergency Fuel Distribution Protocol." Ontario Ministry of Community Safety and Correctional Services. Last modified 25 May 2016: https://www.emergencymanagementontario.ca/english/emcommunity/ProvincialPrograms/ci/emergency_fuel_distribution_protocol.html

- Operations Centre – 600 kW generator with1895 L tank
- Town Hall – 200 kW generator with 1485 L tank

The development of a more comprehensive inventory of both portable and automatic back-up generator units would be valuable in future emergency preparedness efforts. Some jurisdictions, including other municipalities within Durham Region have developed generator inventories that in addition to municipally owned units have also collected details regarding privately owned generators from local businesses willing to make their units available during an emergency event.

The infrastructure assets within the ERP have been assigned a priority ranking between one and three, with one being critical to operations, two less critical and priority three as non-critical. A summary of the critical infrastructure and associated priority ranking is included in **Table 11** below:

Table 11: Priority Ranking of Infrastructure Assets according to Town of Ajax ERP

Type of Critical Infrastructure	Component	Priority
Sewer Pumping Station	Sewer	1
Water Treatment Plant	Water Plant	1
Water Supply Plant	Water Supply	1
Food Depot	Loblaws Food Depot	2
Electrical Transmission & Distribution	Veridian Offices	1
Electrical Transmission & Distribution	Westney Sub Station	1
Electrical Transmission & Distribution	Applecroft Sub Station	1
Electrical Transmission & Distribution	Dowty Sub Station	1
Electrical Transmission & Distribution	Monarch Sub Station	1
Electrical Transmission & Distribution	Notion Sub Station	1
Electrical Transmission & Distribution	Pickering Beach Sub Station	1
Telephone Wire Lines	Switching Station	1
Mail Delivery	Post Office	3
Oil Industry	Pipeline	3
Steam Heat	Steam Plant	Winter 1/Summer 3
Snow Removal	Plows/Sand/Salt	2
Railway	C.N. Lines	2
Railway	C.P	2
Evacuation	School Buses	2
Highway	401	1
Transit System	Offices/Garage/Buses	2
Emergency Operations Centre	Emergency Operations Centre	1

Type of Critical Infrastructure	Component	Priority
Evacuation Centre	Ajax Community Centre	3
	MacLean Community Centre	3
Fire Services	Fire Stations Equipment	1
	Fire stations Equipment	1
	Fire Stations Equipment	1
Emergency Medical Services	Ambulance Facilities and Vehicles	2
Hospital	Lakeridge Health Ajax Pickering	1
Municipal Operations	Municipal Office	1
Reception Centre	OLG Slots	2

Of note is the ranking of evacuation centres as non-critical. The methodology behind priority ranking was not confirmed through the Technical Working Group. The ERP references the Durham Region Emergency Master Plan and Durham Region Emergency Social Services Response Plan with respect to the provision of emergency social services, including reception and evacuation centres. A review of the Durham Region Emergency Master Plan is found in **Section 4.2** of this report. Further discussion regarding evacuation centres and cooling centres is found in **Section 6.2.**

A loss of power to the infrastructure assets listed in **Table 11** could have negative consequential impacts on service delivery or result in injury, loss of life, environmental damage, or property damage and economic loss on a minor or major scale. Extreme rainfall leading to flooding of underground electrical equipment may lead to power outages. The Durham Community Climate Adaptation Plan has proposed a number of approaches to safeguard its assets from flooding. These actions include:

- Preventative measures
- The location or re-location of equipment to areas outside those that are at risk of flooding
- Ensuring flood control infrastructure is adequate.
- Protection measures
- Ensuring the design of equipment is capable of withstanding submersion; and
- Ensuring that barriers are in place to prevent overland floods from reaching equipment.

4.1.5 Inconsistencies within the Emergency Response Plan

In reviewing the ERP, it was noted that Annex E, Primary and Secondary EOC Layout has not been labelled and referenced consistently throughout the Plan. In future versions of the document, it would be recommended that Section 9 of the ERP, Acronyms, Glossary and List of Annexes be repositioned to the beginning of the document to provide readers with contextual information that may be helpful to comprehending the Plan.

A current, comprehensive and easy to understand ERP is a valuable tool for all stakeholders who may be engaged during an emergency event caused by climate change.

4.2 Durham Region Emergency Master Plan

The Durham Region Emergency Master Plan (Master Plan) was approved by Council by By-law 36-2015 on June 24, 2015. The Record of Amendments included within the document, indicates the Master Plan is reviewed on an annual basis, with the most review occurring in January 2018. The Master Plan is posted on the Region's website, meeting the requirement under *Emergency Management and Civil Protection Act* to provide copies to the public.

The Region's prioritized risks were determined to include:

- Transportation emergency;
- Energy supply emergency;
- Severe weather (i.e., snow storms and blizzards, ice storm, lightening, extreme temperature, tornado, wind storm, hurricane)
- Hazardous materials incident;
- Explosion/fire;
- Major flood;
- Human health emergency;
- Critical infrastructure failure; and
- Nuclear emergency;

Due to the two-tiered system of local government within the Durham Region, public services are provided locally or regionally. The Town's Critical Infrastructure was discussed in **Section 4.1.4**. The Region's Critical Infrastructure includes:

- Regional government buildings;
- Drinking water supply and sewer systems;
- Regional emergency services facilities and operations;
- Emergency management facilities;
- Regional roads;
- Transportation systems;
- Long- term care facilities;
- Waste management facilities; and
- Child care services;

The Critical Infrastructure identified by both the Town and the Region have been included in this study.

The Durham Emergency Management Program Committee (DEMPC) has been established in conformance with the *Emergency Management and Civil Protection Act* and includes the following members:

- Chief Administrative Officer, Durham Region (Chair);
- CAO of each member municipality within the Region;
- Chief of Durham Regional Police;
- Commission and Medical Officer of Health;
- Chief, Emergency Medical Services;
- Commissioner of Social Services;
- Commissioner of Works;
- Commissioner of Corporate Services;
- General Manager, Durham Region Transit;
- Director of Corporate Communications;
- Director of Emergency Management; and
- Other representatives as determined by the Chair;

The Regional Emergency Levels outlined in this plan define the classification of emergency events and the appropriate actions and monitoring that DEMO will undertake along with them. Beyond day-to-day operations which consist of normal response by operating departments, there are three defined levels. Level One indicates a Routine Emergency. Emergencies at this level are responded to by first responders (police, fire, and/or EMS) with the potential of needing a multi-agency response for a short period of time and/or a potential to escalate to Level Two. Level Two indicates a major emergency is taking place whereby there is an abnormal situation outside of day-to-day response. A coordinated emergency response is necessary by local municipalities and first responders with the potential for EOC activation. Level Three indicates that an emergency has evolved into an incident requiring a multi-agency response effort, activation of the MEOC and the potential for a Declaration of Emergency. This type of event is likely to exceed municipal resources at this point and full activation of the REOC is required.

External partners have been identified in the Master Plan including but not limited to Durham Regional Police Services, School boards, Conservation Authorities and other community agencies including NGOs who will support the Reginal effort to respond to an emergency while maintaining their own emergency operations.

The Master Plan indicates that mutual assistance agreements are in place with the following jurisdictions:

- York Region;
- Region of Peel;
- Halton Region;

- Northumberland County;
- County of Peterborough;
- City of Toronto;
- City of Peterborough;
- City of Hamilton;

Agreements are currently under development with the Simcoe County and the City of Kawartha Lakes.

Our research and project experience indicates there are defined roles and responsibilities for the Province, Conservation Authorities (CAs) and municipalities in the event of a flood event. The Town of Ajax falls under the jurisdiction of both the Toronto and Region Conservation Authority (TRCA) and Central Lake Ontario Conversation Authority (CLOCA). The roles and responsibilities of these agencies are listed within the Toronto and Region Conservation Authority's 2017 Flood Contingency Plan as described in the sections below.

4.2.1 Provincial Role

Within the province of Ontario the Ministry of Natural Resources and Forestry (MNRF) is assigned the lead role in managing flood forecasting and warning and flood control operations. These roles and responsibilities include:

1. *Operate and maintain a provincial forecasting and warning system to alert MNRF District Offices and Conservation Authorities of potential meteorological events that could create a flood hazard.*
2. *Maintain communications with MNRF District Offices and Conservation Authorities regarding the status of provincial flood potential.*
3. *Receive messages from CAs, MNRF District Offices and other agencies and provide analysis and information that is used to guide the MNRF's response to a flood.*
4. *Assists the MNRF Districts where CAs do not exist in the preparation of river response forecasts, daily planning cycle, and the monitoring of local storm conditions.*[47]

4.2.2 Conservation Authority Role

Where Conservation Authorities exist, their role with respect to flooding and flood events includes the following:

1. *Support municipal flood emergency planning by providing technical advice pertaining to flood risk (e.g., hydrology, hydraulics, flood vulnerable areas, etc.) and where applicable, engage in flood mitigation projects to reduce flood risk prior to flood events.*

[47] 11. Source: "Flood Contingency Plan." Toronto and Region Conservation Authority, 2017: https://trca.ca/app/uploads/2016/02/TRCA-2017-Flood-Contingency-Plan-for-web-.pdf

2. *Maintain a local network, collect data, and monitor watershed and weather conditions daily in order to provide timely warning of anticipated or actual flood conditions (i.e., operate a flood forecasting and warning system). Provide updated forecasts and other supporting technical data pertaining to flood conditions under their jurisdiction during an event.*
3. *Issue flood messages to municipalities and other appropriate agencies, including the media and the public, to advise of potential flooding when appropriate.*
4. *Operate Conservation Authority dams and flood control structures to reduce the effects of flooding when appropriate.*
5. *Maintain communications with municipalities and the Surface Water Monitoring Centre of the MNR during a flood event.*[48]

4.2.3 Municipal Role

Municipalities have the primary role for responding to flooding and flood emergencies to protect the welfare of residents and protection of property. The municipality's roles, upon receiving a Flood Advisory or Flood Warning include:

1. *Notify appropriate municipal officials, departments and agencies in accordance with their municipal emergency plan.*
2. *Determine the appropriate response to a flood threat and, if warranted, deploy municipal resources to protect life and property.*
3. *If required, declare a flood emergency and implement their Emergency Procedures Plan.*
4. *Request Provincial assistance under the Emergency Management and Civil Protection Act, if municipal resources are inadequate to respond to the emergency.*
5. *Maintain liaison with Conservation Authority Flood Coordinators.*[49]

4.3 Ontario Best Practices Observations

Research into current municipal, regional and conservation authority's best practices in Ontario indicates the following findings:

- The major causes of flooding within urbanized settings can be attributed to one of three primary causes including; increased hard surfaces due to urbanization, capacity of older storm water management infrastructure and climate change that is predicted to increase the number of extreme weather events in Ontario;
- Municipalities are recognizing the need to develop specific flood response plans as a result of the increasing frequency of flood related events and the potential impacts on community and residential infrastructure and the life safety of residents, business owners and emergency responders;

[48] Ibid.
[49] Ibid.

- Conservation Authorities have taken a proactive approach to collaboration and development of flood contingency plans, and specifically working together on developing the Lake Ontario Shoreline Management Plan;
- Conservation Authorities, in collaboration with the MNRF, have developed a comprehensive provincial flood watch and warning system. This includes a specific system for Lake Ontario and the Georgian Bay Shoreline. For the Lake Ontario Shoreline, including the Town of Ajax this includes the following;
    - ***Flood Watch – Lake Ontario Shoreline***
      Defined as a notice of the potential that critical high water levels and waves conditions may exist, which could result in shoreline flooding and/or erosion.
    - ***Flood Warning – Lake Ontario Shoreline***
      Defined as a notice that critical high water levels and waves are imminent and/or occurring, which will result in shoreline flooding and/or erosion.
- Municipalities and Conservation Authorities have recognized the need for and implemented more comprehensive public education strategies to enhance overall emergency preparedness and specifically awareness of the potential for flooding. This includes addressing how residents can be better prepared. As an example, the Toronto and Region Conservation for the Living Centre website (https://trca.ca/conservation/flood-risk-management/prepare/) includes a range of flooding education for residents and links to other Government of Canada flooding preparedness information.

4.4 Current Local Flood Response Planning Documents

Research identified a variety of relevant documents that are directly related to the risks associated with waterfront flooding, contingency planning and risk specific response to flooding events in the Town of Ajax.

Stormwater Quality Retrofit Study (2011)

This study was initiated to assess local stormwater discharge where water quality control was lacking. This study was developed in response to multiple years of poor water quality along the waterfront in Ajax which resulted in limited public use of the Town's beaches. Subsequently, there have been increased recreational opportunities along the shores of Ajax.

Toronto and Region Conservation Authority- Flood Contingency Plan (2017)

This plan was updated in January 2017 and includes information related to the Central Lake Ontario Conservation Authority Flood Warning and Watch program. The Flood Contingency Plan was developed in association with the Greater Toronto Area (GTA) Conservation Authorities, and provides information related to flood prevention, mitigation, preparedness, response and recovery pertaining to flood related events.

Central Lake Ontario Conservation – Watershed Flood-Risk Assessment (2017)

Dated April 2017, the Central Lake Ontario Conservation Watershed Flood-Risk Assessment is in keeping with current industry best practices for developing a flood risk assessment, including assessing flood vulnerability, flood event likelihood, and impacts resulting from flood events (evaluated with consideration of social, economic and development factors).

The CLOCA – Watershed Flood-Risk Assessment (2017) identifies "Flood Damage Centres" (FDC) that are defined within the assessment as when the floodplain engulfs buildings such as homes or businesses of the immediate area of the floodplain. Flood damage centres may include one building or hundreds of buildings.[50]

Towards Resilience- Durham Community Adaptation Plan (2016)[51]

The 2016 Durham Community Climate Adaptation Plan used projections and modelling prepared by SENES Consultants as well as the results of stakeholder consultation and a review of municipal best practices to develop programs to build resilience within Durham Region. The programs include cross sectoral initiatives as well as those specific to building, electrical, flooding, human health sectors, roads and natural environment sectors.

4.5 Work Instruction- Building Profile and Information Sheet

In response to discussion during Technical Working Group Workshop #2 relating to pre-planning activities within the Town, Ajax Fire & Emergency Services provided a document entitled Building Profile and Information Sheet. The document sets out the process fire department personnel follow to review and analyse a building in preparation for an emergency event. The process includes identifying occupancy size, hazards, and fire protection equipment/systems. Anecdotally it was confirmed that pre-plans including a building's schematics are available to responding crews who utilize on-board apparatus laptops equipped with CriSys software.

[50] Source: "Central Lake Ontario Conservation Watershed Flood-Risk Assessment." Central Lake Ontario Conservation, April 2017: http://cloca.ca/about/2017_Agendas_Minutes/Report_sr5517_17%20Attachment_CLOCA%20Watershed%20Flood-Risk%20Assessment%20Report_S_April.pdf

[51] Source: "Towards Resilience: Durham Community Climate Adaptation Plan." 2016: https://www.durham.ca/en/living-here/resources/Documents/EnvironmentalStability/DCCAP_TextOnly.pdf

5.0 Transportation Systems

Durham Regional Transit and GO Transit provide transit within the City, while Highway 401 bisects the Town. There are only four streets allowing transportation from the north to the south end of town. In our experience, there is congestion in the area of Salem Road and Highway 401 during peak hours due to lane reductions. These challenges may be intensified in the event of an emergency. Discussion about commuter traffic is included in **Section 3.10** of this report.

As noted throughout this Emergency Preparedness and Response report, transportation systems are integral in ensuring emergency responders are able to quickly respond to an emergency, road networks also enable persons to evacuate areas affected by a climatic event. When roads become impassable or congested due to unsafe conditions, damage to infrastructure or increased traffic flow, both emergency response and evacuation may be compromised, further compounding the impact of the emergency. Delayed response may result in poorer outcomes for victims of the emergency, and also create worsened conditions for first responders, which could impact their personal safety.

During severe storms, extreme temperatures or precipitation events, there is potential for damage to electrical infrastructure and trees. Downed wires may require roads to be closed, delaying emergency response and evacuations. Such incidents may also increase the workload of first responders responsible for securing the area or for responding to the resultant calls for assistance. Tree conflicts with electrical and transmission infrastructure is addressed in **Section 5.0** of the Natural Capita Report of this study.

Flood vulnerable buildings and roads are spatially represented in **Figure 5** of the Stormwater and Overland Flooding Report of this study. Through visual analysis of the figure, roads in an area north of Highway 401, west of Chapman Drive and also in an area southeast of Highway 401 and Bayly Street are identified as flood vulnerable according to data received from the Toronto and Region Conservation Authority.

Consideration of the proximity to public transit and evacuation routes in relation to evacuation centres, reception centres and cooling centres is discussed in **Section 6** of this report.

6.0 Vulnerable Buildings

Throughout this study, the terms “vulnerable buildings” and “vulnerable occupancies” are used. These terms are not synonymous and the distinction between the terms is defined in the following section. To clarify, some vulnerable occupancies are also classified as vulnerable buildings, not all vulnerable buildings are classified as vulnerable occupancies.

6.1 Vulnerable Buildings (Assets)

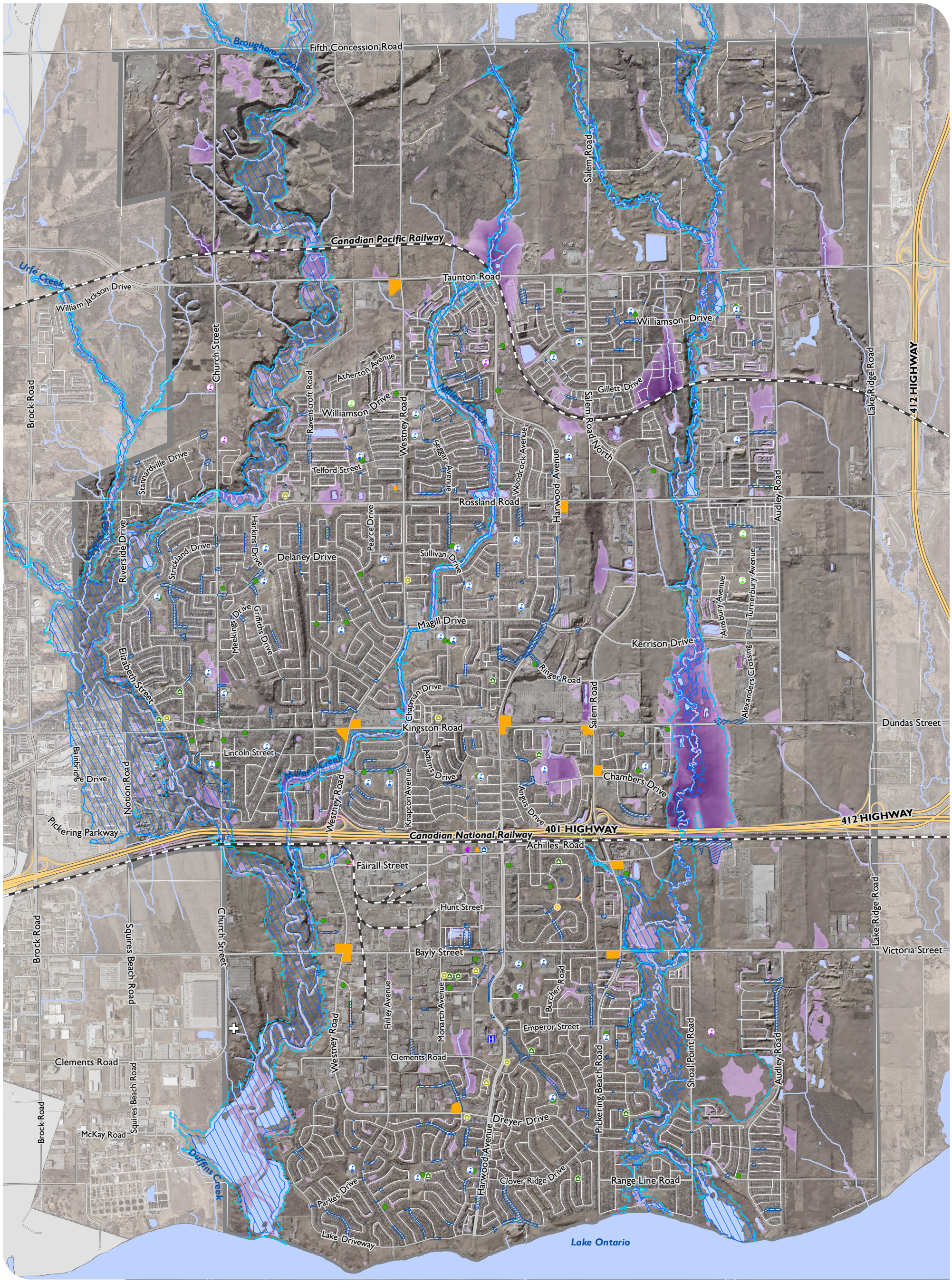
For the purposes of this study, the term “vulnerable buildings” refers to those occupancies used primarily by the priority population discussed in **Section 3** of this report and includes the following:

- licenced child care facilities;
- retirement homes;
- schools;
- long term care facilities;
- emergency shelters;
- housing outreach services;
- social housing;
- group homes; and
- detention centres;

The risk assignment for vulnerable buildings was either high or low based on proximity to riverine flood lines and overland flooding extents. Those buildings located inside the riverine flooding areas, inside or close proximity to overland flooding were designated as high risk, due to the potential for a threat to life safety, large loss of life, and/or evacuation/displacement of a large number of persons. This risk assignment is related to the potential impact to priority populations living in or being served by the building to be impacted. Comparatively, those buildings outside the riverine flooding areas, without proximity to overland flooding extents have a lower risk of flooding and therefore less potential for risk to life safety or conditions.

Figure 4 provides a spatial representation of those buildings identified as vulnerable. Vulnerable buildings with a high risk assignment include:

- Childcare facilities;
- Elementary and Secondary Schools;
- Emergency Shelters;
- Group Homes; and
- Social Housing.



TOWN OF AJAX
COMMUNITY CLIMATE STUDY

VULNERABLE BUILDINGS (ASSETS)
FIGURE 4

- Hospital
- Long Term Care
- Retirement Home
- Existing School
- Future School
- School Under Construction
- Childcare Facility
- Affordable Housing
- Emergency Shelter
- Housing Outreach Services
- Social Housing
- Group Home
- Detention Centre

Vulnerable Buildings - Assets (Assigned Risk Level)

- High
- Low
- Gas Station Zoning
- 100 Year Climate Change Overland Flooding Extent
- 100 Year Climate Change Riverine Flooding
- Railway
- Regional Floodline

Depression (m)
High : 0
Low : -8.87717

DILLON CONSULTING

2017 Breaklines, Contours, Drainage or DTM provided by © First Base Solutions
2017 Orthophotography provided by © First Base Solutions

1:32,000
0 250 500 1,000 m

MAP CREATED BY: GM
MAP CHECKED BY:
MAP PROJECTION: NAD 1983 UTM Zone 17N

PROJECT: 187286 STATUS: DRAFT DATE: 2018-10-12

FILE LOCATION: \\dillon.ca\DILLON_DFS\Toronto\Toronto GIS\187286 - Town of Ajax Community Climate Study\mxd\Emergency Response\Figure 4 Vulnerable Buildings (Assets).mxd

6.1.1 Vulnerable Occupancies

The term "vulnerable occupancy" refers to any care occupancy, care and treatment occupancy or retirement home regulated under the *Retirement Homes Act, 2010.* Examples include hospitals, long term care facilities, certain group homes and retirement homes. Ontario Regulation 364/13 requires fire departments to perform fire safety inspections and fire drill scenarios in certain occupancies on an annual basis and to file certain information about vulnerable occupancies with the Office of the Fire Marshal and Emergency Management. A comprehensive fire safety inspection will also involve reviewing the Fire Safety Plan for each vulnerable occupancy. Performing fire safety inspections and witnessing and approving fire drill scenarios will, amongst other things, assist the fire department in assessing the evacuation capabilities within these occupancies. The fire department verbally confirmed its fire prevention bureau utilizes OFMEM's Vulnerable Occupancy Registry.

6.1.2 Fire Department Pre-Plans

As discussed previously, Ajax Fire & Emergency Services does have a process in place to develop pre-plans for buildings. A pre-plan includes information details about a building's occupancy, construction, layout, hazards, special considerations and features. This information is used and considered to "pre-plan" for an emergency response at the property. Through the data collection phase of this project, it was confirmed that Ajax Fire & Emergency Services has pre-plans available for some properties in either hard copy or electronic formats.

The work of Ajax Fire & Emergency Services relating to both the OFMEM's Vulnerable Occupancy Registry and fire department pre-plans provides crucial information and awareness to firefighters during emergency responses. Completing these tasks requires significant time and commitment. Expanding the use of these initiatives to include all vulnerable buildings, not just vulnerable occupancies, would provide a higher level of preparedness on a Town-wide scale.

6.2 Evacuation Centres, Reception Centres and Cooling Centres

In the event of an emergency related to precipitation, severe weather and temperature, the use of an evacuation centre, reception centre and/or cooling centre may be required. Developing a list of facilities suitable to accommodate these functions, will avoid unnecessary delay during an emergency.

6.2.1 Evacuation Centres

Evacuation centres are those facilities which may provide safe, temporary shelter during an evacuation. Evacuation centres should include ample washroom and shower facilities, be equipped with back-up power, with space appropriate to accommodate sleeping and eating. These facilities should be inspected by the fire department and public health units in advance of an emergency to ensure compliance with adequacy from a life safety perspective.

During workshop #2, the relocation of an evacuation centre from the Town's South East to a facility in the North East was discussed. While the present location is located within close proximity of many of the vulnerable buildings identified in **Figure 4**, it was noted that the proposed new location has a larger capacity and is equipped with a back-up generator. Concerns were expressed about the distance to the proposed new location for those who may be displaced from the South East area of the Town, including patients at the hospital.

As discussed in **Section 3.11** of this report, the Town may choose to develop a list of criterion by which to evaluate the location of potential evacuation centres, reception and cooling centres. The list below is not intended to be an exhaustive list of those factors the Town may choose to include as part of its evaluation; it does however provide insight into objective based criteria which may be considered.

- Proximity to priority populations to accommodate those who may require special or additional assistance in the event of an emergency;
- Presence of back-up generator power;
- Kitchen/cafeteria facilities;
- Population density;
- Washroom and shower capacity;
- Proximity to public transit routes;
- Sufficient floor area to accommodate cots; and
- Compliance with federal, provincial and municipal legislation.

6.2.2 Reception Centres

Reception centres are facilities made available during an emergency that provide a place for to the public to receive information about the emergency. While a reception centre does not provide sleeping accommodations, it may provide light refreshments and a place to charge cell phones. Like evacuation centres, reception centres should be identified in advance of an emergency and inspected by the fire department and health unit, as appropriate. Reception centres and cooling centres may be co-located. Cooling centres are discussed below.

6.2.3 Cooling Centres/Splash Pads

Cooling centres provide an opportunity for the public to access a climate controlled environment during a severe and prolonged heat event or hot weather emergency. Cooling centres are often part of a hot weather plan that may be included in a jurisdiction's Emergency Response Plan, or can be developed as a separate document. The City of Toronto has developed a Hot Weather Response Plan which establishes roles and responsibilities for a variety of agencies and departments during a heat event, protocols for notification and activation of the Hot Weather Response Plan, as well as a strategy to communicate with the public.

It was noted during Workshop #2 that the Town does not currently have a cooling centre, however this is an initiative being considered to address heat related events. The Durham Region Climate Change Adaptation Plan also considers heat reduction strategies as part of the "Cool Durham" program.

Splash pads have been identified on **Figure 5**. In the future, the Town may wish to consider adding sun shelters to **Figure 5** as these facilities fulfill the objective to reduce ambient summer temperatures in urban areas in order to reduce heat stress.[52]

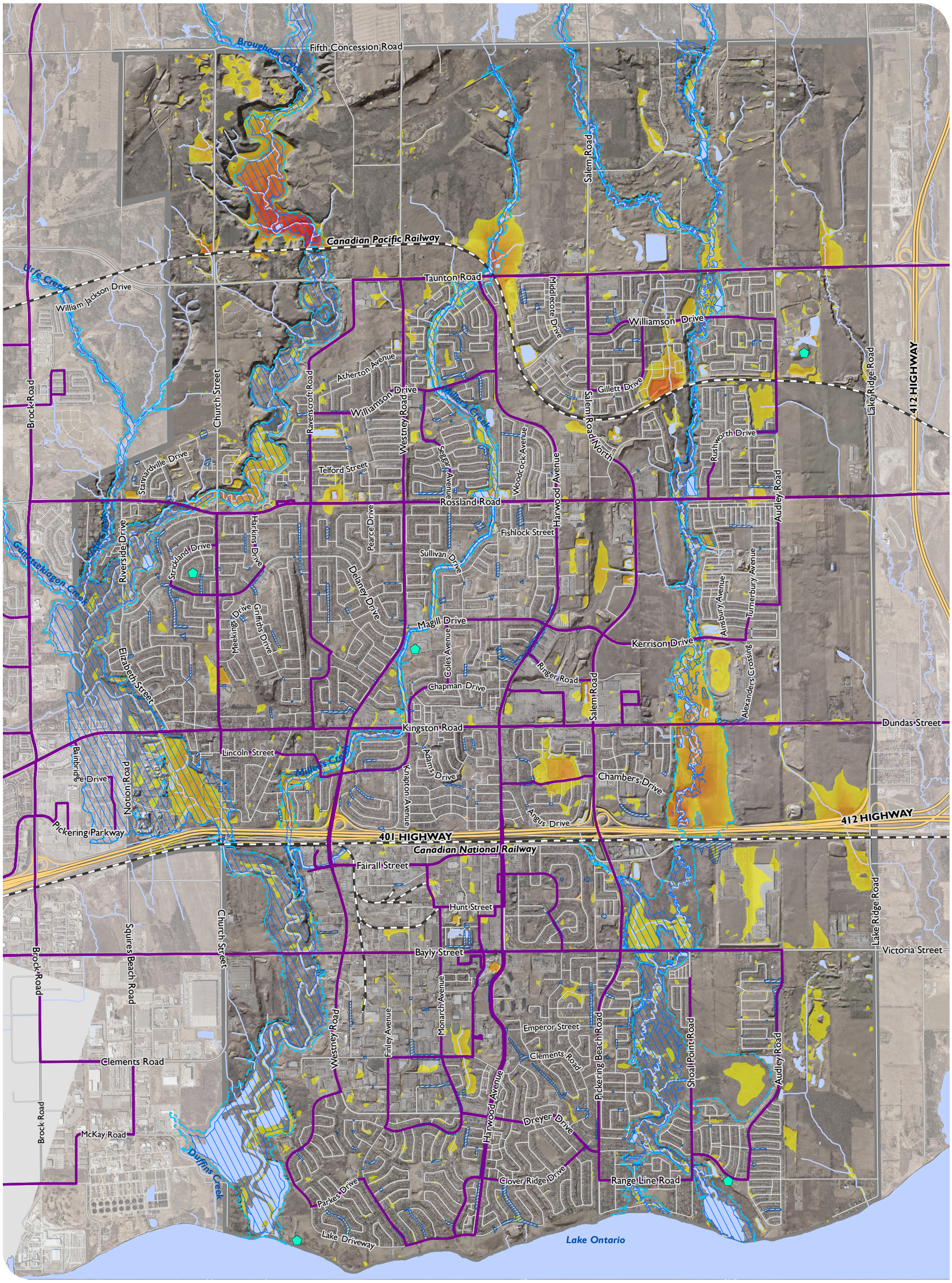
The Town of Ajax owns and operates a total of five splash pads which are located in the following areas:

- Carruthers Marsh Pavilion;
- Rotary Park;
- McLean Community Centre;
- Audley Recreation Centre; and
- Horne Park.

All splash pads listed are open 7 days/week from 9a.m. to dusk when weather permits.[53]

There would be value to adding both splash pads and sun shelters to a Hot Weather Response Plan. Similar to the discussion in **Section 3.11** and previously in **Section 6** of this report, the Town may wish to consider developing a criterion by which to evaluate potential splash pads and sun shelters accommodate those who may benefit from programming and services which mitigate the impact of climate change, including priority populations.

[52] Towards Resilience, 2016.
[53] Source: "Pools and Splash Pads." Town of Ajax: https://www.ajax.ca/en/experienceerecreation/pools.asp



TOWN OF AJAX
COMMUNITY CLIMATE STUDY

SPLASH PADS

FIGURE 5

Splashpad
Durham Region Transit
100 Year Climate Change Overland Flooding Extent
100 Year Climate Change Riverine Flooding
Railway
Regional Floodline

Depression (m)
High : 0
Low : -8.87717

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MAP CREATED BY: GM
MAP CHECKED BY:
MAP PROJECTION: NAD 1983 UTM Zone 17N

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0 250 500 1,000 m

PROJECT: 187286 STATUS: DRAFT DATE: 2018-10-12

FILE LOCATION: \\dillon.ca\DILLON_DFS\Toronto\Toronto GIS\187286 - Town of Ajax Community Climate Study\mxd\Emergency Response\Figure 5 Splash Pads.mxd

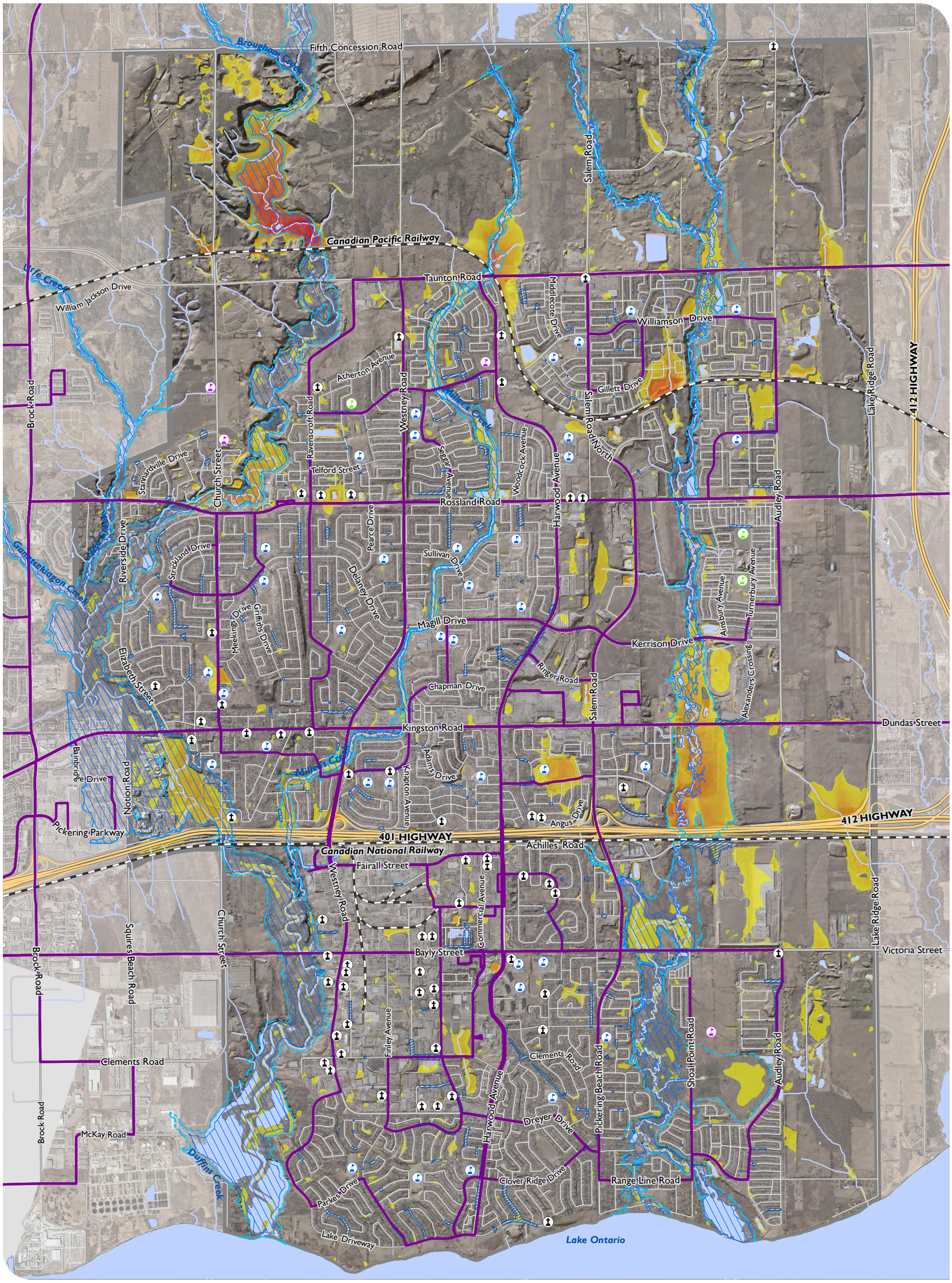
6.3 Alternatives to Evacuation and Cooling Centres

An alternative to the evacuation centres established by the Town includes use of places of worship. The City of Brampton (see **Section 3.2.1**) utilizes its faith based community to close the gap in outreach to its vulnerable populations, engaging the community's established volunteer base and facilities.[54] This strategy is not meant to replace local municipal efforts but to support and increase the resiliency of the community, improving a municipality's ability to respond to extreme weather events.

School gymnasiums also provide an advantage by providing an alternative evacuation centre for those who may be displaced and cannot reach the evacuation centres predetermined by the Town's ERP. In some jurisdictions, reciprocal use agreements exist between the municipality and the school boards, allowing the parties to make use of the each other's facilities at no cost. Developing an agreement with the local school boards or including the use of school facilities during emergency events in an existing agreement may warrant consideration.

Figure 6 identifies schools and places of worship that could potentially be used to provide evacuation spaces or an alternative to reception centres. Existing and future schools, in addition to schools in the construction phase, are included in the figure provided. These alternative sites would require coordination with the Town to ensure they are incorporated into the Emergency Response Plan. Incorporating these buildings into the Town's ERP would also require the facilities meet the requirements of the fire department and public health unit (see also **Sections 3.11** and **5.2.1**).

[54] Source: Collaborative Implementation Groups: Case Study Series: City of Brampton. ICLEI – Local Governments for Sustainability Canada Office. January 2018.



TOWN OF AJAX
COMMUNITY CLIMATE STUDY

POTENTIAL RECEPTION/EVACUATION CENTRES

FIGURE 6

- Existing School
- Future School
- School Under Construction
- Place of Worship
- Durham Region Transit
- 100 Year Climate Change Overland Flooding Extent
- 100 Year Climate Change Riverine Flooding
- Railway
- Regional Floodline

Depression (m)
High : 0
Low : -8.87717

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FILE LOCATION: \\dillon.ca\DILLON_DFS\Toronto\Toronto GIS\187286 - Town of Ajax Community Climate Study\mxd\Emergency Response\Figure 6 Potential Reception_Evacuation Centres.mxd

6.4 Critical Infrastructure (Vulnerable Buildings - Services)

The risk assignment for assets that have been identified as critical infrastructure is either high or low based on proximity to riverine flooding or overland flooding extent. Critical infrastructure inside riverine flooding and/or inside or in close proximity to overland flooding extent were considered identified as high risk with the greatest potential for loss of service to a large amount people on a city wide scale. A risk assignment of low was used to identify critical infrastructure outside riverine flooding areas with no proximity to overland flooding extend. This left potential for some loss of service or service interruption to a low number of people on a neighbourhood scale.

Figure 7 provides a visual representation of the critical infrastructure identified as high risk.

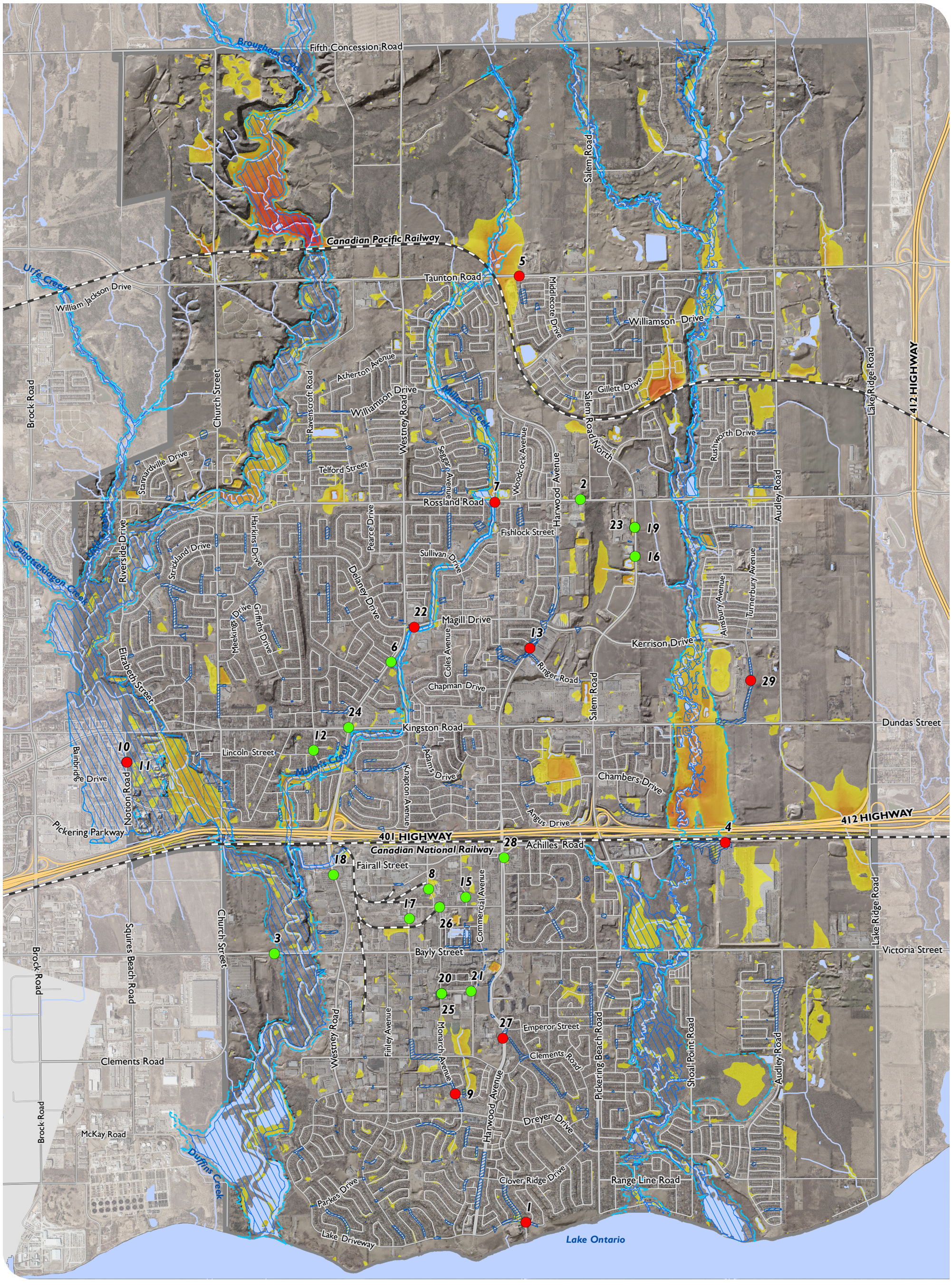
The analysis shown through GIS modelling provides some insight into what critical infrastructure within the Town of Ajax are at an increased risk of flooding. Most critical infrastructure assets categorized as high risk were found to be located in close proximity to overland flooding extents. It is to be expected that water will surpass the areas defined within the map for urban flooding. The urban setting is comprised of concrete impermeable materials that are not ideal for retaining water. In the event of increased precipitation where water is not absorbed through natural means, storm sewers and drainage systems are taxed and flooding ensues. Flooding of assets critical to the functioning of a municipality can have widespread social, environmental and economic impacts as well as prolonged disruptions to essential services that can affect a few individuals locally to a large number of people on a regional scale.

To mitigate the effects of a changing climate on the most critical infrastructures, Public Safety Canada has proposed a *National Strategy*[55] that promotes collaboration as a key component in strengthening the resiliency of critical infrastructure in Canadian cities.

This Strategy contains three main objectives:

- Build partnerships to support and enhance critical infrastructure resiliency.
- Implement an all-hazards approach to risk management.
- Advance the timely sharing and protection of information among partners and key stakeholders.

[55] Source: "National Strategy for Critical Infrastructure." Public Safety Canada. Last Modified 31 January 2018: https://www.publicsafety.gc.ca/cnt/rsrcs/pblctns/srtg-crtcl-nfrstrctr/index-en.aspx#s4_1



TOWN OF AJAX
COMMUNITY CLIMATE STUDY

CRITICAL INFRASTRUCTURE

FIGURE 7

Critical Infrastructure (Assigned Risk Level)
- High
- Low

- 100 Year Climate Change Overland Flooding Extent
- 100 Year Climate Change Riverine Flooding
- Railway
- Regional Floodline

Depression (m)
High : 0
Low : -8.87717

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MAP CREATED BY: GM
MAP CHECKED BY:
MAP PROJECTION: NAD 1983 UTM Zone 17N

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PROJECT: 187286 STATUS: DRAFT DATE: 2018-10-12

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Critical infrastructure identified with a high risk assignment are included in **Table 12** below.

Table 12: Critical Infrastructure Assigned High Risk

Sector	Type of CI	Component	Owner/Operator	Location to Overland Flooding and/or Riverine Flooding
Food/Water/Sewer	Water Treatment Plant	Water Plant	Region of Durham	Close proximity to overland flooding area
Food/Water/Sewer	Food Depot	Loblaws Food Depot	Loblaws	Close proximity to overland flooding area
Electricity	Electrical Transmission & Distribution	Veridian Offices	Veridian Connections	Within depression zone
Electricity	Electrical Transmission & Distribution	Applecroft Sub Station	Veridian Connections	Within riverine flooding boundary
Electricity	Electrical Transmission & Distribution	Monarch Sub Station	Veridian Connections	Close proximity to overland flooding area
Electricity	Electrical Transmission and Distribution	Notion Sub Station	Veridian Connection	Within riverine flooding boundary
Electricity	Electrical Transmission and Distribution	Pickering Beach Sub Station	Veridian Connection	Within riverine flooding boundary
Tele-Communications	Mail Delivery	Post Office	Canada Post	Close proximity to overland flooding area
Public Safety and security	Fire Services	MacLean Community Centre	Town of Ajax	Close proximity to overland flooding area
Public Safety and Security	Hospital	Lakeridge Health Ajax Pickering	Lakeridge Health	Close proximity to overland flooding areas
Public Safety and Security	Reception Centre	OLG Slots	OLG	Close proximity to overland flooding area

6.4.1 Gas Station Zoning

A key critical infrastructure for further consideration is critical infrastructure pertaining to the oil and natural gas sector**. Figure 4** (**Section 6.1**) includes gas station zoning areas within the Town of Ajax. Those areas where zoning that would permit gas stations have been mapped within this study due to the elevated risk for environmental damage that is brought about by flooding to Underground Storage Tanks (UST). The U.S. Environmental Protection Agency has listed four main impacts to underground UST systems that might occur as a result of extreme precipitation or flooding events.[56] These include:

1. **Buoyancy**: an UST system surrounded by floodwaters or saturated soil is subjected to buoyant forces that could offset the restraint of backfill, pavement, or hold-down straps, causing the tank to shift in the backfill from its location. If the UST is unanchored, it may lift out of the ground and float, resulting in a rupture or separation of the connecting pipes, releasing product into the environment;
2. **Erosion and scour**: forces of rapidly moving water can cause soil erosion and scour. Exposing the system to stressors from flood water pressure or floating debris makes it even more vulnerable to being undermined or collapse. Underground piping can also shift and become detached from the UST, releasing product into the environment;
3. **Product displacement**: water or other debris can enter an UST through openings such as fill pipes, vent pipes, gaskets, loose fittings, covers, sumps, and damaged tank walls. As water and debris settle on the bottom of the UST, product will rise and float on top until it exits the tank through openings, releasing product to the environment; and
4. **Electrical system damage**: extended contact with floodwaters may cause damage to electrical equipment associated with UST systems (such as automatic tank gauging systems, panel boxes, emergency shutoff switches, submersible turbine pumps, dispensers, motors, cathodic protection, etc.).

Of the gas station zones identified in **Figure 4**, two zones are within or near the overland flooding extent. These sites should be considered in future flood planning for their flood potential.

[56]Source: "Underground Storage Tank Flood Guide." United States Environmental Protection Agency, 2010: https://www.epa.gov/sites/production/files/2014-03/documents/ustfloodguide.pdf

7.0 Population Density

Population density refers to the measurement of population in an area. In the event of an emergency, more densely populated areas may be vulnerable to increased traffic congestion and potential transit disruptions, leading to delayed evacuation and/or response times by emergency responders. It was confirmed with fire department personnel that primary response route are those used by Durham Region Transit. It was also confirmed that fire department personnel are tasked with monitoring the road network for construction and other potential delays in an effort to avoid unnecessary delay during a response.

Anecdotal evidence provided at Technical Working Group Workshop #2 suggests Ajax Fire & Emergency Services has developed a database of high rise complexes within the Town. It was unclear what information regarding these buildings has been collected. A future consideration may include modelling the Town's building stock by occupancy type, using Municipal Property Assessment (MPAC) to visually display residential and non-residential areas.

There were three categories of risk assignment used to rate population density as displayed in **Table 13** below.

Table 13: Three Categories of Risk for Population Density

Risk Assignment	Rationale
High	The potential for high numbers of deaths, injuries and/or persons displaced/evacuated in the event of an emergency;
Medium	The potential for injuries with isolated instances of fatalities or serious injuries and long-term illness and isolated instances of displacement of persons on a widespread scale;
Low	The potential for minor injuries and isolated instances of temporarily displaced people in localized areas

High Density areas include densely populated residential areas and the downtown regional centre. Due to the high number of persons living and working within this area, the consequence of a climate change related event is greater than other areas within the Town that have a lower density population. The higher population density leaves the potential for higher numbers of deaths, injuries and/or persons being displaced/evacuated in the event of an emergency.

Moderately dense areas include somewhat dense residential land use, spaces of general employment, mixed use areas, the midtown corridor, areas of prestige employment and the village regional centre.

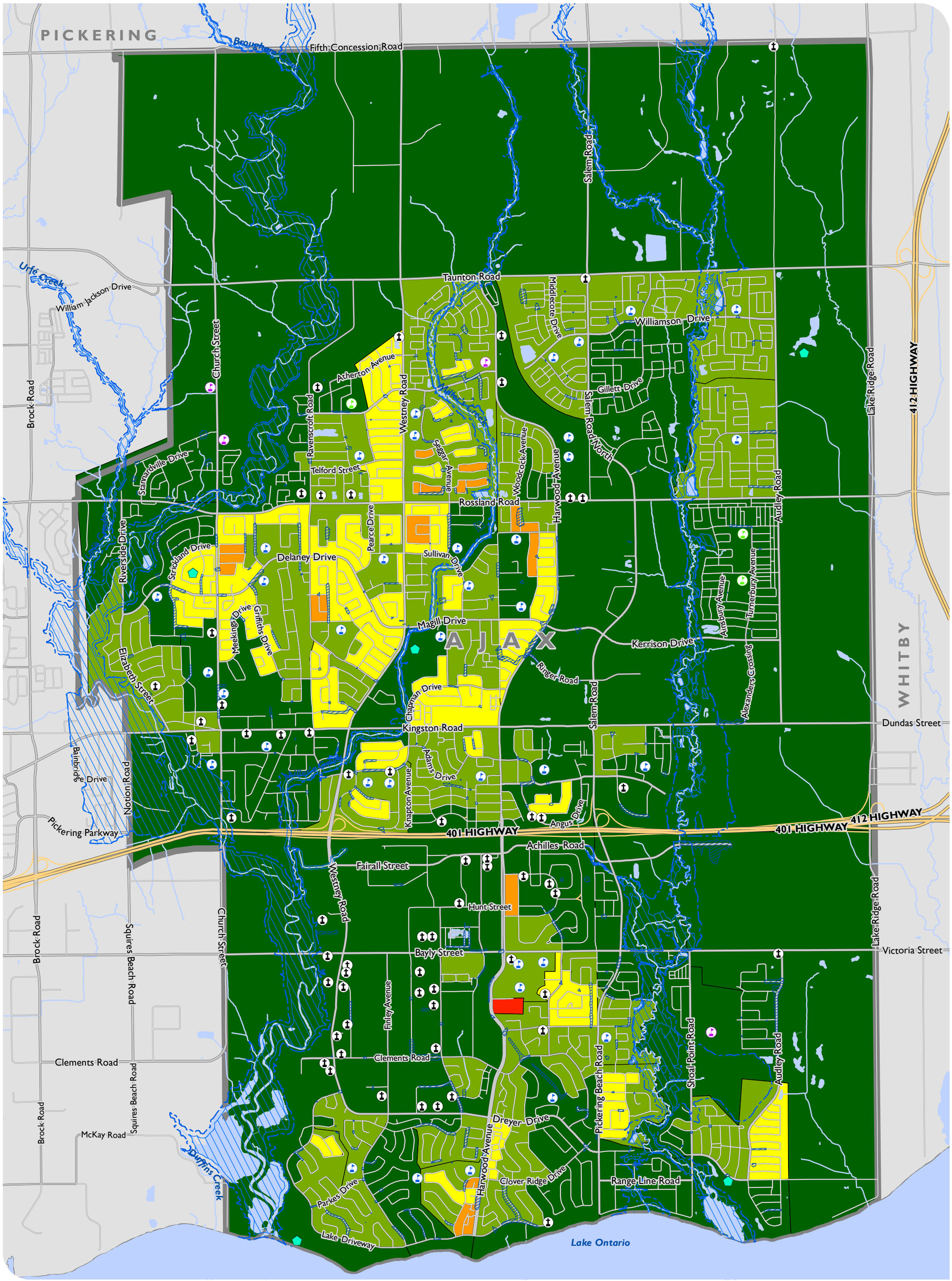
Due to a medium amount of people living and working in this area, the consequence of a climate change related event would be moderate. There would be potential for injuries or cases of illness with isolated instances of fatalities or serious injuries and long-term illness as well as isolated instances of temporary/permanently displacement persons on a widespread scale.

Comparatively, low density areas consist of land designated for environmental protection, open spaces, rural areas and the shore of Lake Ontario. Due to the low number of persons living and working within this area, the consequence of a climate change related event is lower than other areas within the Town that have a higher population density. A low population density leaves the potential for minor injuries and isolated instances of temporarily displaced people in localized areas.

Figure 8 provides a visual representation of the population density throughout the Town of Ajax, as well as the locations of potential reception and/or evacuation centres. As discussed in **Section 6.2.1**, the Town may choose to create a list of criterion by which to evaluate the location of potential evacuation, reception and cooling centres. Population density could be one criterion by which to evaluate potential locations. Given the potential for greater consequence of a climate change related event in highly populated areas, the proximity of shelters to densely populated centres is an important consideration as is the shelter's capacity to accommodate a high number of persons.

Future population growth is another factor that the Town may consider when evaluating potential shelter locations. Population projections for 2051[57] have been spatially represented in **Figure 9** in addition to the location of potential reception and evacuation centres and splash pads. The potential shelters mapped include existing schools and places of worship, schools that are currently in the site plan or construction phase as well as schools that are planned for the future. Further discussion on the alternatives to evacuation centres can be found in **Section 6.3**.

[57] Durham Community Energy Plan



TOWN OF AJAX
COMMUNITY CLIMATE STUDY

POPULATION DENSITY WITH POTENTIAL RECEPTION/ EVACUATION CENTRES

FIGURE 8

- Splashpad
- Existing School
- Future School
- School Under Construction
- Place of Worship
- 100 Year Climate Change Overland Flooding Extent
- 100 Year Climate Change Riverine Flooding
- Floodline

Population Density (people/km²)

70 - 3072
3073 - 5609
5610 - 8454
8455 - 17300
17301 - 40105

1:32,000
0 250 500 1,000 m

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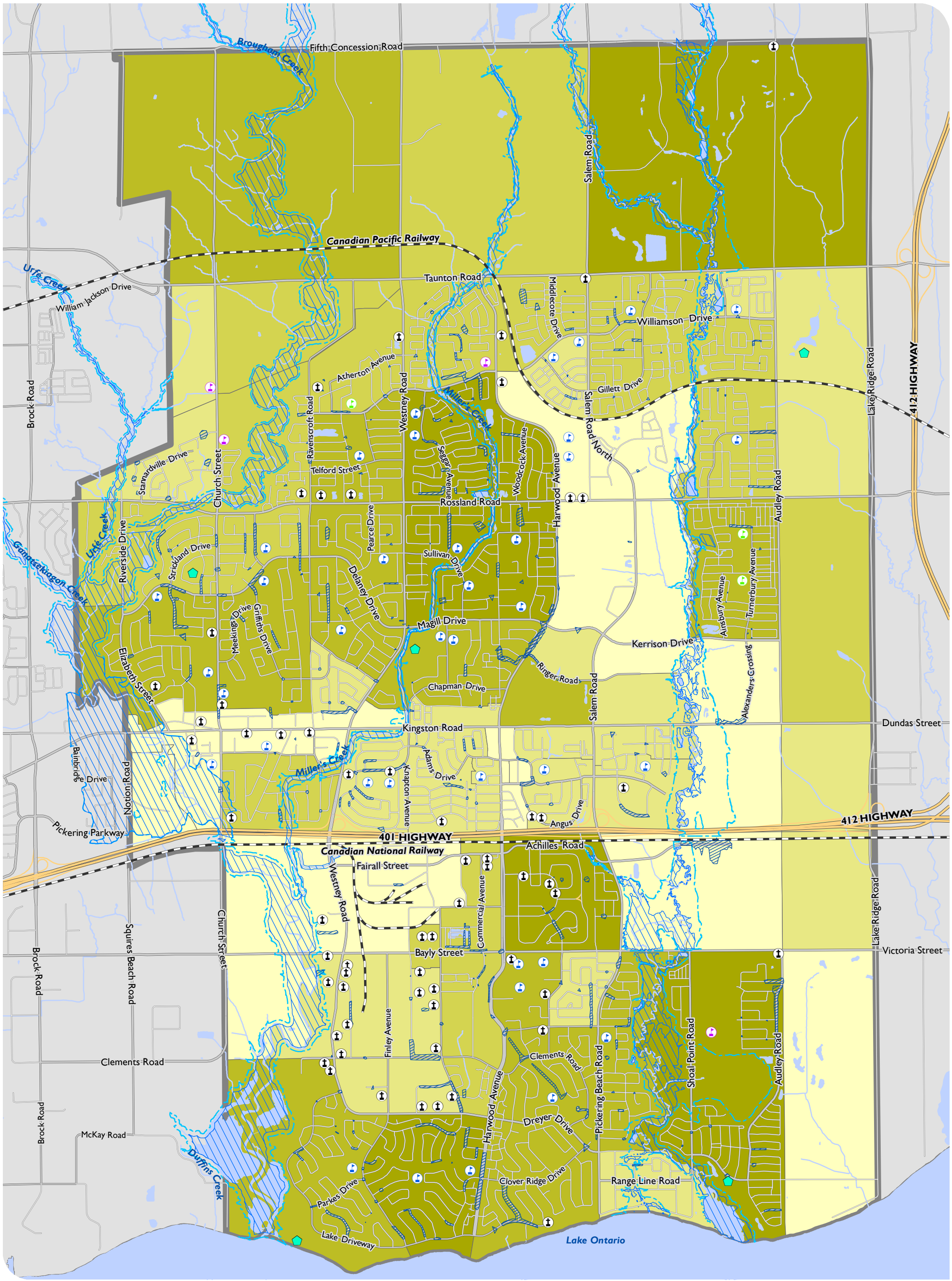
MAP CREATED BY: GM
MAP CHECKED BY: JP
MAP PROJECTION: NAD 1983 UTM Zone 17N

PROJECT: 187286 STATUS: DRAFT DATE: 2018-10-12

FILE LOCATION: \\dillon.ca\DILLON_DFS\Toronto\Toronto GIS\187286 - Town of Ajax Community Climate Study\mxd\Emergency Response\Figure 8 Population Density with Potential Reception_Evacuation Centres.mxd



TOWN OF AJAX
COMMUNITY CLIMATE STUDY

POPULATION PROJECTIONS WITH POTENTIAL RECEPTION/ EVACUATION CENTRES

FIGURE 9

- Splashpad
- Existing School
- Future School
- School Under Construction
- Place of Worship
- 100 Year Climate Change Overland Flooding Extent
- 100 Year Climate Change Riverine Flooding
- Railway
- Regional Floodline

Population Projection (2051)

- 0 - 599
- 600 - 1527
- 1528 - 2731
- 2732 - 3875
- 3876 - 5855

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MAP DRAWING INFORMATION:
DATA PROVIDED BY AJAX,
DURHAM REGION COMMUNITY ENERGY PLAN

MAP CREATED BY: GM
MAP CHECKED BY:
MAP PROJECTION: NAD 1983 UTM Zone 17N

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PROJECT: 187286 STATUS: DRAFT DATE: 2018-10-12

FILE LOCATION: I:\GIS\187286 - Town of Ajax Community Climate Study\mxd\Emergency Response\Figure 9 Population Projections with Potential Reception_Evacuation Centres.mxd

8.0 Summary

Table 14 below provides a summary of populations and properties that have the potential to be impacted by climatic events as well as emergency preparedness and response considerations and has been adapted from information made available by the Office of the Fire Marshal and Emergency Management. These considerations take into account response and also recovery phases of an emergency event.

Table 14: Summary Table

Climatic Event	At Risk/Impacts	Emergency Preparedness and Response Considerations
Heat related events	• Long-term Care Facilities • Healthcare Facilities • Large gatherings, community events, festivals	• Need for shelter or cooling centres • Municipal Tree Maintenance Program • Need for cooling equipment • Water supply, distribution, and rationing • Debris clean-up • Evacuation, particularly of people residing/working in known flood-prone areas or damaged housing and priority populations
Cold weather events	• Long-term Care Facilities • Health Care Facilities • Schools • Closed roads • Lack of external support	• Warming centres with cots and food supplies • Need for generators and fuel for essential services • Need for heating equipment • Emergency shelter for stranded travellers • Responding to building collapse emergencies • Search and rescue • Drop in/reception centres (e.g. hot meals and update on emergency situation)
Year-round Hazards, including increased precipitation	• Damage to institutions • Reduced travel • Reduced spending in an area • Failure of automated systems • Disruption to movement and supply of critical goods and services	• Listen for the warnings from Environment Canada - Weather Watch/Weather Warning • Timely emergency information and/or direction to the public through the media • Managing hazardous materials incidents/fires resulting from a transportation emergency • Disaster and emergency financial assistance • Short-term reception/evacuee centres and care of evacuees • Medium to long-term accommodation • Emergency medical services and health care • Maintenance and restoration of critical infrastructure

Climatic Event	At Risk/Impacts	Emergency Preparedness and Response Considerations
		• Care and protection of animals (livestock and companion) • Disposal of spoiled food supplies • Debris disposal • Road/bridge clearing and maintenance

Source: Adapted from "Guideline for the Development of a Municipal Flood Emergency Plan."[58]

8.1 Summary of Recommendations

A number of recommended actions for consideration were posed throughout this report. A summary of these recommendations is listed below:

1. Consideration should be made to developing emergency response procedures that consider the needs and circumstances of those identified as priority.
2. Establishing cooling centres and splash pads within built up urban areas can be an effective way of providing relief from rising temperatures to priority individuals who do not have access to air conditioning.
3. The linguistic and cultural needs that may exist in these areas should be considered when developing and implementing emergency preparedness initiatives.
4. When evaluating potential sites evacuation centres and/or emergency shelters, the Town may choose to consider including criterion relating to the proximity to the locations with the highest number of priority populations in an effort to accommodate them.
5. The development of a database that inventories both human and physical resources that could be made available in the event of an emergency would be a useful tool.
6. An alternative method of communicating with the family of affected staff such as a fan out system, text or email notification would be recommended.
7. There may be opportunity to provide training to local partners in advance of an event ensuring an increased level of preparedness should their assistance be required during an emergency.
8. Having three potential persons responsible for the role of Emergency Information Officer (EIO) has advantages, primarily, allowing the Fire Chief and/or Deputy Fire Chief to remain focused on operational emergency tasks rather than on communication with elected officials, the public and the media during an emergency.
9. Consistent use of terms throughout the Emergency Response Plan and annexes would relieve any uncertainty regarding terms used.

[58] Guideline for the Development of a Municipal Flood Emergency Plan, 2016.

10. Preparing a more comprehensive Flood Emergency Preparedness Plan or updating the current Emergency Preparedness Plan with copies of all relevant flood plans may be a future consideration to ensure the entire Town has been included in preparedness efforts.
11. The Town may choose to develop a list of criterion by which to evaluate the location of potential evacuation centres, reception and cooling centres.
12. The development of a more comprehensive inventory of both portable and automatic back-up generator units would be valuable in future emergency preparedness efforts.
13. It would be recommended that Section 9 of the ERP, Acronyms, Glossary and List of Annexes be repositioned to the beginning of the document to provide readers with contextual information that may be helpful to comprehending the Plan.
14. Expanding the use of initiatives such as the OFMEM Vulnerable Occupancy Registry and fire department pre-planning to include all vulnerable buildings, not just vulnerable occupancies, would provide a higher level of preparedness on a Town-wide scale.
15. Further discussion regarding developing a registry identifying prioritized populations may be a consideration, however it would be recommended that advice be obtained from the Town's legal department to ensure information is collected and retained in accordance with the Municipal Freedom of Information and Protection of Privacy Act.
16. There would be value to adding both splash pads and sun shelters to a Hot Weather Response Plan.
17. Developing an agreement with the local school boards or including the use of school facilities during emergency events in an existing agreement may warrant consideration.
18. There are two areas identified that permit gas stations that are within or near the overland flooding extent. These sites should be considered in future flood planning for flood potential.
19. A future consideration may include modelling the Town's building stock by occupancy type, using Municipal Property Assessment (MPAC) to visually display residential and non-residential areas.
20. It is recommended that the ERP be reviewed through the lens of climate change.