The Office of Emergency Management
Hazard Identification and Risk Assessment

Edmonton

SECTION 1 | Document Management and Control

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INTRODUCTION

The City of Edmonton's Office of Emergency Management is responsible for the identification of potential hazards and associated risks which could adversely affect the City as a corporation, its citizens, the economy and the environment.

A Hazard Identification and Risk Assessment, or HIRA, is a tool that helps to examine the probability and impact of hazards and assess their risk. The process helps to determine which hazards pose the greatest risks, how likely they are to occur, and how great the potential impact will be to the community.

The HIRA used by the City of Edmonton is adapted from the Province of Alberta Community Emergency Management Program and the Hazard Identification and Risk Assessment Workbook. This HIRA is focused on disaster risk and is intended to complement, not replace or supersede, Enterprise Risk Management processes, procedures, and policies. The HIRA process adheres to accepted international risk management principles and standards of practice, but focuses on risk assessment related to disaster events rather than the broader practice of risk management.

The results of the HIRA process allow the City to make informed decisions to address underlying vulnerabilities in social, economic and natural environments. Understanding these risks also allows for the development of strategic plans to deal with potential emerging risks.

Edmonton has not been immune to disasters and significant emergencies. In addition to these well known hazards, there are also growing trends related to changing factors such as population density, urbanization, technology dependence, climate, as well as changes in human induced events like terrorism.

BACKGROUND

The Hazard Identification and Risk Assessment process is a component of the Municipal Emergency Plan, which is required by the provincial *Emergency Management Act*.

The HIRA must be completed on a regular basis (at least annually) to ensure all hazards are recognized and changes to frequency or impact are identified. The kinds of hazards that are most likely to significantly impact a community are not static; new hazards appear and other hazards change.

For example, the societal shift towards reliance on technology has created new hazards. These events may cause physical damage, or digital disruption to information and critical technological infrastructure. As well, in recent years the damage caused by severe weather events has emerged as the leading cause of property insurance claims. Environment Canada reports that severe weather events that used to happen every 40 years can now be expected to happen every six years.

The results of the HIRA process help to provide an understanding of the hazard exposure and associated risks that exist in Edmonton so we eliminate or mitigate risks, and plan and prepare for where we can't.

METHODOLOGY

There are hazards and threats to the city by the nature of its geographical location, climate, industries, and other factors. Threats are also presented by people who may be within or outside the city, some of whom may inadvertently cause harm or have intent.

> **"Hazards are sources of potential harm or loss. Emergencies and disasters result when a hazard interacts with a vulnerability to produce serious and adverse consequences that may, for an undetermined period of time, exceed the ability to cope."[1]**

The Office of Emergency Management identifies hazards and threats that present the greatest risk of harm to the city. These hazards are ranked according to probability, impact, and changing risk by using a tool called a Hazard Identification and Risk Assessment, or HIRA. The results can be used to prioritize mitigation and hazard specific strategies.

A HIRA is not intended to predict which threats and hazards will cause the next emergency. Instead, it provides an overview of the collection of risks most likely to cause damage in our community.

[1] *An Emergency Management Framework for Canada, Second Edition*

The City's HIRA is completed in alignment with the City's Enterprise Risk Management Program, which looks at risks that threaten the operations of each branch and the corporation as a whole. Several of the risks identified through the Enterprise Risk Management Program are the same as those identified and assessed in the HIRA. However, in emergency management hazards are contemplated in terms of impact to the City as a whole, including its citizens, infrastructure, and environment. For example, a pandemic will impact the business operations of the organization (Enterprise Risk), but it will also significantly impact the healthcare system, citizens, and the ability for businesses to function (Emergency Management Risk).

The methodology used for the City's HIRA is adapted from the Alberta Emergency Management Agency's Hazard Identification and Risk Assessment Workbook to align with *Canadadian Standards Association and International Organization for Standardization (CSA ISO) 31000 Risk Management - Guidelines*. This standard outlines a high level framework that provides a common approach to managing any type of risk and the steps included in an effective risk management process.

The methodology of this process includes three steps.

Step One: Hazard Identification

The purpose of a hazard identification is to find, recognize and describe hazards that could significantly impact the City. Relevant, appropriate and current information is exceptionally helpful when identifying hazards, although it is not always available for new or evolving hazards.

In this first step of the HIRA, hazards which have occurred, or have the potential of occurring, and causing significant damage or consequence are identified. Each hazard is categorized as natural, technological or human-caused.

Natural hazards are caused by natural forces, like tornadoes, floods, and pandemics, and can occur without the influence of people. Natural hazards have the potential to directly or indirectly impact the City's operations, people and environment. Secondary hazards may result from, or happen concurrently with, a natural hazard event.

Technological hazards are usually caused by the unintentional malfunction of technology, including human and system failures. These hazards originate from industrial or technological accidents, infrastructure failure, or other activities and can result in loss of life, damage to property, socioeconomic disruption, or environmental impact. Drinking water disruption, a rail incident, natural gas disruption, and an explosion are all examples of technological hazards.

Human-caused hazards are caused directly by human action or inaction, either intentionally or unintentionally, resulting in an impact on people, property, and/or environment. Examples of human-caused hazards include bomb threats, a nuclear event, civil disorder and cyber attack.

Step Two: Risk Analysis

The purpose of the risk analysis is to fully understand the nature of the risk associated with each hazard. Risk analysis involves a detailed consideration of uncertainties and risk sources.

In step two of the City's HIRA, a risk analysis is completed for each of the identified hazards, which involves researching past hazard occurrences. It also includes examining the current vulnerability of the community to determine the probability of the hazard occurring at an intensity that could result in damage, and the potential impacts of the hazard on people, property, the environment, business, the economy and critical infrastructure.

Step Three: Risk Evaluation

Each potential hazard needs to be assigned a numerical value to allow for comparison. Once the data is compiled and analyzed, it highlights hazards that should be considered a priority in terms of resource allocation, planning, preventing, reducing, mitigation, and management.

In Step Three we evaluate each hazard against criteria inherent in risk; probability, cumulative impact, and changing risk. Each of these is assigned a numerical value and inserted into the following risk equation.

Risk = (Probability) (Cumulative Impact) (Changing Risk)

Probability and Frequency Factor

Probability is the likelihood of something happening, whether defined, measured or estimated objectively or subjectively. Probability considers how often an event has occurred in the past using historical information, allowing us to consider if an event may occur in the future and, if so, how often it may occur.

Table 1 assigns a numerical value to categories of risk which was used for all hazards identified for the City of Edmonton. Note that only hazards that are determined to be likely, probable, and unlikely within the City of Edmonton are included in the HIRA process.

Table 1: **Probability and Frequency**

Probability	Category	Description
1	Rare	Hazards with return periods of >100 years
2	Very Unlikely	Occurs every 50 – 100 years
3	Unlikely	Has occurred in the past 50 years
4	Probable	Has occurred in the past 25 years
5	Likely	Occurs < 5 years. Hazard can occur annually, including seasonal events.
6	Almost Certain	The hazard occurs every year.

Consequence

The consequence of each hazard is derived from historical information regarding the impact of past incidents, as well as estimates of potential impact on the city. Consequence is divided into six categories, specifically:

a. social impact
b. damage to property
c. damage to critical infrastructure
d. environmental damage
e. business and financial impact
f. psychosocial impacts

When assigning consequence values for each category, consider a **historic high magnitude event** that **resulted in significant impact** in each category.

After a value has been assigned for each category, they are compiled to find the total consequence value. Each type is discussed below.

a. Social Impact

Social impact refers to the **direct** negative consequences of a hazard on the physical health of people (mental health is included in the psychosocial section). The social impact variable is further divided into

- fatality rate;
- injury or illness; and,
- evacuation rate.

The impact score for each will be included in the cumulative impact total.

Table 2: **Social Impact Variable (Fatalities)**

Impact	Category	Description
0	None	Not likely to result in fatalities.
1	Minor	Could result in fewer than 5 fatalities within the community.
2	Moderate	Could result in 5 to 10 fatalities within the community.
3	Severe	Could result in 10 to 50 fatalities within the community.
4	Catastrophic	Could result in more than 50 fatalities within the community.

Table 3: **Social Impact Variable (Injuries or Illness)**

Impact	Category	Description
0	None	Not likely to result in injuries or illness within the community.
1	Minor	Could injure and/or cause illness in fewer than 25 people.
2	Moderate	Could injure and/or cause illness in 25 to 100 people.
3	Severe	Could injure and/or cause illness in more than 100 people.

Table 4: **Social Impact Variable (Evacuation)**

Impact	Category	Description
0	None	Not likely to result in an evacuation, shelter-in-place orders, or people stranded.
1	Minor	Could result in fewer than 100 people being evacuated, sheltered-in-place or stranded.
2	Moderate	Could result in 100 to 500 people being evacuated, sheltered-in-place or stranded.
3	Severe	Could result in more than 500 people being evacuated, sheltered-in-place or stranded.

b. Property Damage Impact

Property damage impact refers to the direct negative consequences of a hazard on buildings, structures and other forms of property like crops or vehicles.

Table 5: **Property Damage Variable**

Impact	Category	Description
0	None	Not likely to result in property damage.
1	Minor	Minor isolated damage, mostly cosmetic. Residential damage.
2	Moderate	Localized neighbourhood damage (several buildings impacted).
3	Severe	Widespread and severe damage affecting several neighbourhoods (numerous buildings impacted).

c. Critical Infrastructure Failure and/or Service Disruption Impact

Critical infrastructure consists of physical and information technology facilities, networks, services and assets that are critical to the well-being, operations and continuity of the City. Infrastructure may be deemed critical if its failure or disruption jeopardizes safety, security and quality of life.

Critical infrastructure may be independent, yet many are interdependent and require another form of critical infrastructure to function. When one system is disrupted, it can result in a cascading effect across other systems. There is also interdependency between the energy sector and other critical infrastructure which can compound the risk.

This impact refers to the negative consequences of a hazard on the interdependent, interactive, interconnected networks of institutions, services, systems and processes that meet vital human needs, sustain the economy, protect public safety and security, and maintain continuity of, and confidence in, local government.

Table 6: **Critical Infrastructure Failure and/or Service Disruption Variable**

Impact	Category	Description
0	None	Not likely to disrupt critical infrastructure services.
1	Minor	Could disrupt 1 critical infrastructure service.
2	Moderate	Could disrupt 2 or 3 critical infrastructure services.
3	Severe	Could disrupt more than 3 critical infrastructure services.

d. Environmental Damage Impact

This impact refers to the negative effect of a hazard on the environment, including the soil, water, air, plants or animals.

Table 7: **Environmental Damage Variable**

Impact	Category	Description
0	None	Not likely to result in environmental damage.
1	Minor	Could cause localized and reversible damage. Quick clean up is possible. Environmental damage is short term (week to months to recover).
2	Moderate	Could cause major but reversible damage. Full clean up is difficult. Midterm and recoverable environmental damage (i.e., years to recover).
3	Severe	Could cause severe environmental damage. Full clean up is not possible. Long term environmental damage (i.e., decades to recover).

e. Business and Financial Impact

The business and financial impact refers to the negative economic consequences of a hazard on the economic community.

Table 8: **Business and Financial Variable**

Impact	Category	Description
0	None	Not likely to disrupt business and/or financial activities.
1	Moderate	Could result in losses for a few businesses.
2	Severe	Could result in losses for an industry.

f. Psychosocial Impact

This impact refers to the community’s negative response to a hazard, caused by the perception of risk. This includes human responses like anxiety, fear and anger, as well as resultant activities including self-evacuation, mass panic, and other potential undesirable responses.

Table 9: **Psychosocial Variable**

Consequence	Category	Description
0	None	Not likely to result in significant psychosocial impacts.
1	Moderate	Significant psychosocial impacts, including limited panic, hoarding, self evacuation, and long term trauma.
2	Severe	Widespread psychosocial impacts, including mass panic, widespread hoarding and self-evacuation,, and long term impacts on emotional and/or mental well-being.

Add up the consequence totals for each category. Use Table 10 to translate the sum of cumulative impact variables can be determined by using Table 10.

The consequence category in the HIRA methodology is a scale of impact, rather than prioritization. The same value in two categories does not mean that the consequences of the two are equal and interchangeable.

Once the total consequence is determined for a hazard using Table 10, the impact value can be identified by using Table 10, which will be included into the risk formula.

Table 10: **Cumulative Impact Total**

Total Consequences	Impact Value	Description
1 to 4	1	Slight
5 to 8	2	Minor
9 to 11	3	Moderate
12 to 15	4	Severe
> 16	5	Very severe

Changing Risk

Hazards and their associated risks are not static. A third variable, changing risk, introduces projected changes of **frequency** and **vulnerability** into the equation, for example mitigation and climate change.

For each hazard answer the questions in Table 11, which considers frequency.

- If the answer is “yes” to two more questions, the score is: **2**
- If the answer is “yes” to one or fewer questions, the score is: **1**

Table 11: **Changing Risk = Frequency**

Is the number of non-emergency occurrences of the hazard increasing?
Are interactions with the hazard likely to increase with human activity (e.g., increased population)?
Are there environmental influences that could cause an increased frequency of the hazard to occur (e.g., climate change)?
Are human factors such as business, financial, or geopolitical situations more likely to increase the risk?

For each hazard answer the questions in Table 12, which considers vulnerability.

- If the answer is “yes” to two or more questions, the score is: **2**
- If the answer is “yes” to one or fewer questions the score is: **1**

Table 12: **Changing Risk = Vulnerability**

Is a large number of the population vulnerable or is the number of people vulnerable to this hazard increasing?
Does critical infrastructure reliance make the population more vulnerable?
Are response agencies aware of, practiced and prepared to respond to this hazard?
Are prevention/mitigation measures currently in place for this hazard?

To determine the numerical value of changing risk for a hazard, insert the numerical values for frequency (Table 11) and vulnerability (Table 12) into this formula.

Changing Risk = Change in Frequency + Change in Vulnerability

The numerical value determined for changing risk is the last number required to complete the risk formula.

Risk = (Probability) (Cumulative Impact) (Changing Risk)

Once the data is compiled and analyzed, each hazard will have a numerical value which allows for direct comparison and prioritization in terms of resource allocation, planning, preventing, reducing, mitigation, and management.

Step Four: Review, Approval and Communication Process

The Office of Emergency Management reviews and updates the HIRA annually by Q2 for reporting to the Emergency Management Agency and the Emergency Advisory Committee in Q3.

The following review process is used:

1. Initial review and updates (identification of new hazards, historical events log and updated scoring of hazards) completed by OEM Officer, Business Continuity Planning Officer and ERM Risk Manager.
2. Updates are circulated with a key group of subject matter experts for review and input to validate identification and scoring of hazards (including Deputy Director Emergency Management Agency (EFRS Deputy Chief of OEM), EPS, EMS, EFRS-Chief of Special Operations and Hazmat, and Epcor).
3. Completed HIRA is used for review to determine if updates are required to the Municipal Emergency Plan and all associated mitigation plans (applicable Standard Operating Procedures (SOP)). Reviewed by EFRS Manager of Accreditation and Improvement
4. The HIRA and the Emergency Management Plan are reviewed annually by the Director of the Emergency Management Agency (City of Edmonton - City Manager).
5. Completed results will be combined with applicable updates to the Municipal Emergency Plan and will be reported to the Emergency Management Agency and the Emergency Advisory Committee.
6. The most current Hazard Identification and Risk Assessment will be available for all applicable partners and stakeholders of the Office of Emergency Management.

Edmonton Demographic Context

Demographics

Edmonton has a population of 972,223 residents (2019 Municipal Census). Within the greater metropolitan region the population is estimated to be at 1,321,426 (2016 Statistics Canada Edmonton Census Metropolitan Area (CMA)). The 2016 census also recorded total private dwellings of 360,825 in the City of Edmonton.

Employment[2]

The Edmonton metropolitan area has a labour force of approximately 849,288.

Top 10 Employment by Industries:

Health care and social assistance	98,081	8.25%
Construction	96,673	8.13%
Retail trade	92,221	7.75%
Public administration	59,827	5.03%

[2] Data from Edmonton Global - https://edmontonglobal.ca/regional-demographics/

Educational services	59,043	4.96%
Professional, scientific and technical services	58,605	4.93%
Accommodation and food services	56,888	4.78%
Manufacturing	50,239	4.22%
Transportation and warehousing	39,664	3.33%
Other services (except Public Administration)	39,364	3.31%

Transportation

Canadian National Railways (east/west), Canadian Pacific Railways (north/south), and Via Rail have routes that pass through Edmonton.

Major highways through and around Edmonton are 2 (Whitemud Drive), 14 (Whitemud Drive), 15 (Manning Drive), 16 (Yellowhead Trail), 16A (Stony Plain Road), 21, 28 (Canadian Forces Trail), 37 and 216 (Anthony Henday Drive).

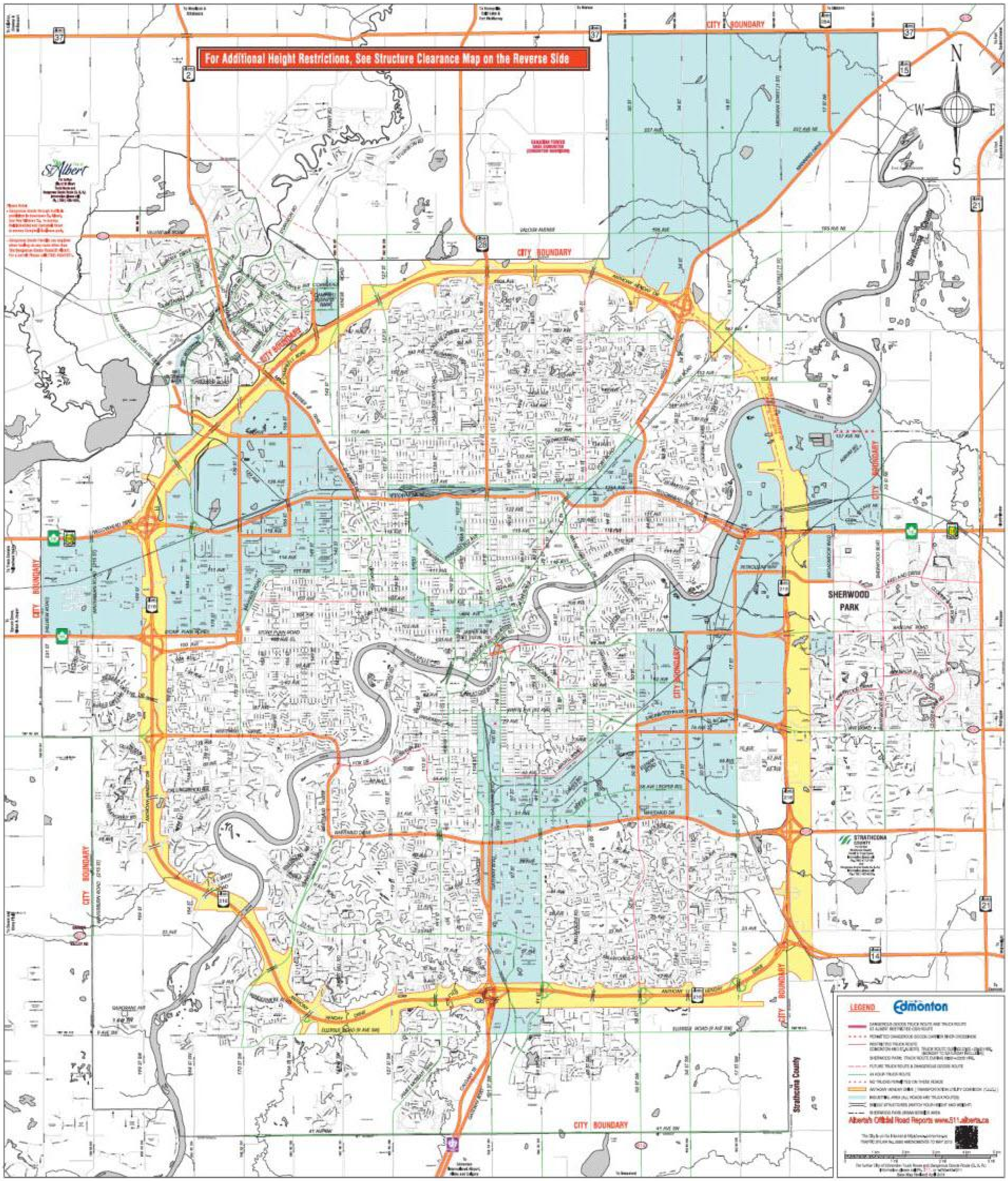
The Edmonton International Airport (EIA) is located 28 kilometres south of the city centre. The EIA supports air passenger traffic of nearly 8,200,000 passengers per year and operates as the 5th busiest airport in Canada. EIA is also the primary cargo hub for northern Alberta, with expanded cargo village operation. EIA is leading rapid growth in cargo transportation services with direct routes from China and Texas, as well as capability in handling the Antonov AN-124 planes, one of the largest planes in the world. In 2021, EIA also announced a further $38 million expansion to the cargo operations. The EIA also operates the Villeneuve Airport which is approximately 35km northwest of Edmonton. Villeneuve Airport is a general aviation, recreational flying and training facility. Situated on 574 HA of land, with two runways, 29 hangers, and over 7000 annual aircraft movements in 2018. ZVL is the largest and busiest general aviation airport in the Edmonton Metro Region.

Several major bridges traverse the North Saskatchewan River, as well as pedestrian bridges and a number of secondary bridge structures that span various creeks in the city. Approximately 107 regional and 254 inter-provincial freight carriers serve the area.

Primary Dangerous Goods Routes

To ensure the safety and security of its residents, Edmonton has a number of designated dangerous goods routes (Map 1). Carriers transporting dangerous goods commodities are restricted to these routes.

Map 1: a - Edmonton Truck Route Map (Front)



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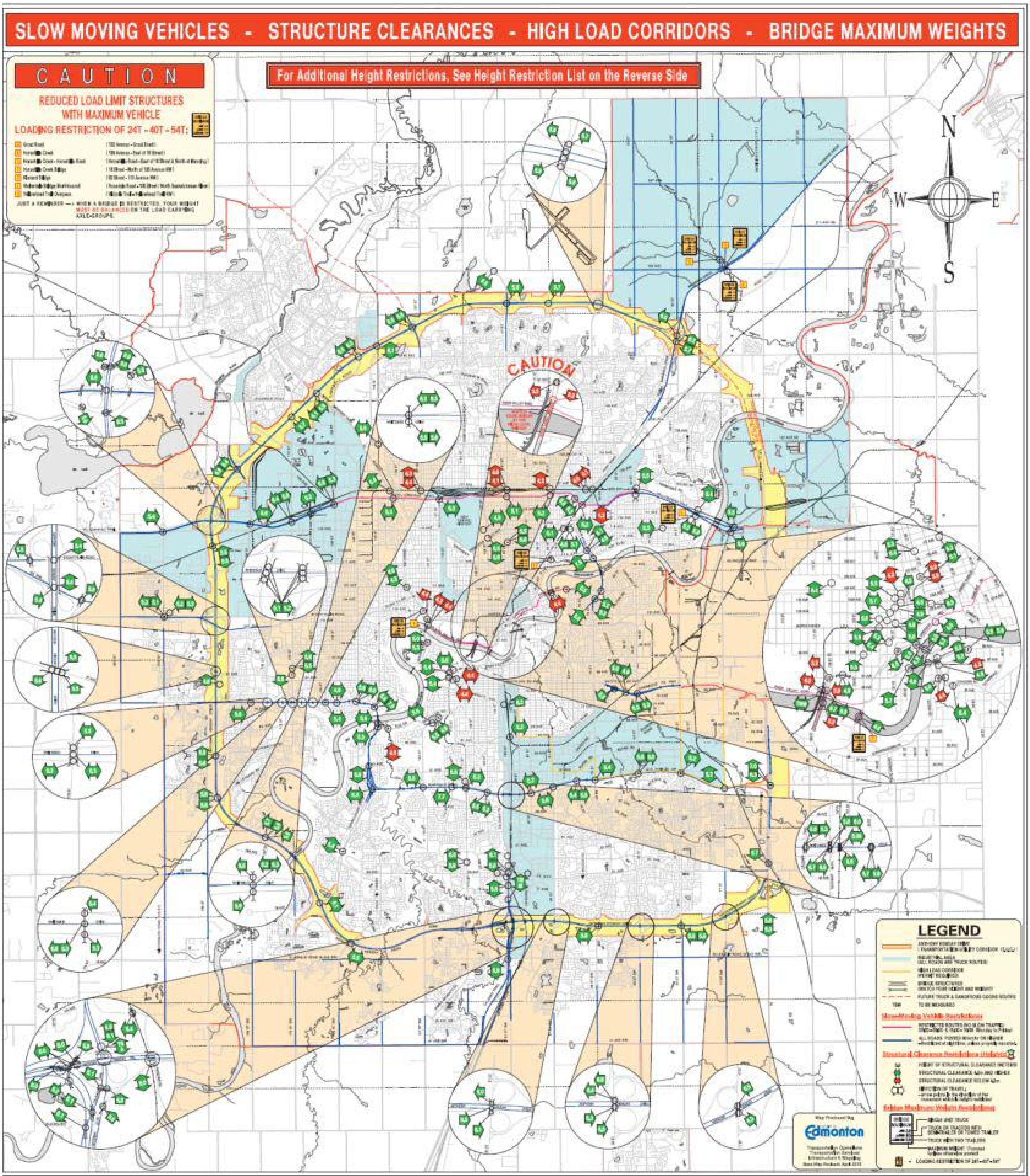
https://www.edmonton.ca/transportation/RoadsTraffic/Apr2015_CoE_Truck_Route_Front_map.pdf

Map 1: b - Edmonton Truck Route Map (Back)



File Location:
https://www.edmonton.ca/transportation/RoadsTraffic/Apr2015_CoE_Truck_Route_Back_map.pdf

Schools – Hospitals – Nursing Homes

There are 423 public, separate, and private schools; three vocational colleges; and four universities. The Alberta Health Services (AHS) Edmonton Zone has 15 hospitals, 11 emergency departments, 1 Urgent Care Centre, and 23 Public Health Centres. There are also approximately 90 public and private operated continuing care facilities (including long term care). Health Link 811 provides a 24-hour, 7-day phone advice and information service.

Hazard Assessments

Hazards are summarized into three main categories:

- **Natural** - hazard based on natural environmental causes beyond human control causing harm.
- **Technological** - hazard based on the failure of man made technology and infrastructure causing harm.
- **Human Induced** - hazards based on the action of humans or human error causing harm.

The main hazards identified for the City of Edmonton as extreme are generally based on Natural Atmospheric causes of mother nature based on our environmental conditions in Edmonton, plus a combination of technology and human based hazards focused mostly on transportation of dangerous goods, hazardous materials and potential for explosions and emissions. These top hazards are all based on potential for impact and likelihood of frequent occurrence. Response standard operating procedures (SOPs) are well documented for these top scenarios through fire rescue services.

Hazard Summary

For ease of organization and reference the following is an alphabetical listing of hazard groups and the related hazards within each group.

Category	Hazard Group	Hazard
Technological / Human Induced	Accidents (Transportation)	• Airplane Crash • Major Road Accident (Vehicular) • Rail Accident
Natural	Atmosphere	• Blizzards (Snow) • Hail

		• Extreme Cold • Tornado • Extreme Heat
Technological / Human Induced	Dangerous Goods/ Hazardous Materials	• Hazmat (Fixed Site) - Pipeline/ Storage Facility • Hazmat (Transportation) - Rail • Hazmat (Transportation) - Road
Natural	Diseases and Epidemics	• Human Health Emergency • Agriculture Plant Disease/ Pest Infestation
Technological / Human Induced	Explosions and Emissions	• Chemical, Biological, Radiological, Nuclear Event • Oil and Gas Emergency • Pipelines • Toxic Gas Release
Natural / Human Induced	Fire	• High Intensity Residential Fire • Forest Fire (Wildfire)
Natural	Geological/ Hydrological	• Flood (Rainfall/ Run-off) • Flood (watercourse) • Landslide • Drought
Human Induced	Public Disorder	• Civil Disturbance • Labour Disputes
Technological	Structural	• Bridge/ Structural Collapse
Human Induced	Terrorism	• Hostile Acts
Technological	Utility Disruption	• Computer/ Hardware/ Software Failure • Communication Equipment / Failure • Natural Gas Disruption • Power Disruption • Water Main Break • Water Pollution/ Contamination • Water Shortage

Hazard Scoring Summary

**Scoring based on March 2021 updates. Appendix*

Priority	Hazard	Risk Score	Risk Level
1	Blizzards	96	Extreme
2	Extreme Cold	96	Extreme
3	Human Health Emergency	96	Extreme
4	Chemical, Biological, Radiological, Nuclear Event	72	Extreme
5	Pipelines	72	Extreme
6	Terrorism	72	Extreme
7	Civil Disturbance	60	Extreme
8	Agricultural Plant Disease / Pest Infestation	54	Extreme
9	Hazmat (Fixed Site) - Pipeline / Storage Facility	54	Extreme
10	Hazmat (Transportation) - Rail	54	Extreme
11	Hazmat (Transportation) - Road	54	Extreme
12	High Intensity Residential Fire	54	Extreme
13	Oil and Gas Emergency	54	Extreme
14	Floods (Rainfall / Run-off)	48	Very High
15	Labour disruptions	48	Very High
16	Major Road Accident (Vehicular)	48	Very High
17	Snow	48	Very High
18	Toxic Gas Release	48	Very High
19	Water Pollution / Contamination	48	Very High
20	Floods (Watercourse)	45	Very High
21	Extreme Heat	36	High
22	Rail Accident	36	High
23	Computer / Hardware / Software Failure	24	Moderate
24	Forest Fire (Wildfire)	24	Moderate
25	Water Main Break	24	Moderate
26	Landslide	20	Low
27	Airplane Crash	18	Low
28	Hail	18	Low
29	Power disruption	12	Low
30	Tornado	12	Low
31	Water Shortage	12	Low
32	Bridge / Structural Collapse	9	Very Low
33	Communication Equipment Failure	9	Very Low
34	Natural Gas disruption	6	Very Low

1 - Detailed Scoring Summary.

<u>Accidents (Transportation)</u>

Transportation incidents can be devastating. A crash could cause such things as injuries, fatalities, fires, transportation and supply disruptions.

Airplane Crash

Risk of airplane crashes has changed greatly due to the decommissioning of the City Centre Airport in November 2013. This has reduced low level flying across the city's downtown landscape. Although there have been at least 30 airplane crashes recorded in Edmonton, mostly involving small private passenger planes around the City Centre Airport (now closed). Although risks are present through the increased large aircraft flight patterns due to the volume of passenger and cargo flights out of Edmonton International Airport (EIA). It is also noted that the Edmonton Airshow has been a major event at the Villeneuve Airport annually in August attracting approximately up to 40,000 spectators.

Date	Major Events[3]
October 27, 1948	Douglas C-54A-15-DC cargo flight crashed shortly after take off due to pilot error killing 2 crew members and injuring 3.
May 26, 1955	Avro 685 York C1 cargo flight crashed on take off into the railway killing the 2 crew members.
January 2, 1973	A Boeing 707-321C cargo plane crashed on landing approach killing 2 crew members, 3 passengers and 86 cows. The plane crashed 3km from the airfield. Crew fatigue and difficult weather conditions due to low clouds, snow falls and turbulence were factors in the crash.
December 6, 1981	Mitsubishi MU-2B-35 Marquise private executive plane crashed into the Royal Alexandra Hospital on landing approach to the City Centre Airport killing the pilot.
March 29, 1985	Two Canadian Armed Forces Hercules transport planes collided in midair near CFB Edmonton killing 10 airmen (it is noted that CFB Edmonton closed its airfield operations in 1994).

Major Road Accident (Vehicular)

Edmonton has not experienced any major roadway accidents like those seen across Canada, such as BC and Ontario highways. However, the threat is ever present with Edmonton's rapid weather changes causing icy or foggy conditions making roads and bridges treacherous. Edmonton has several high-traffic volume roadways, each of which has numerous collisions per year.

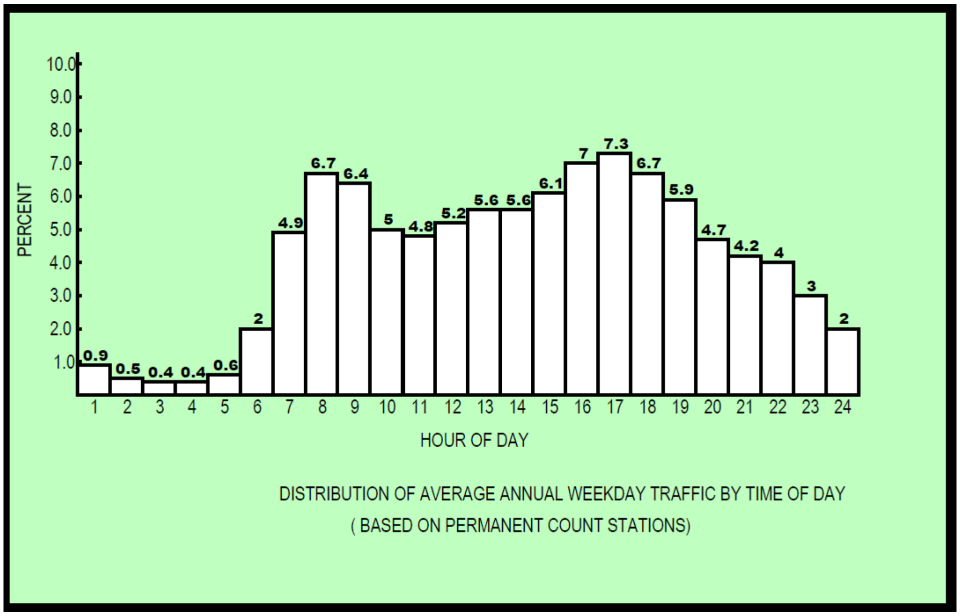
The average daily traffic volumes (2018 Average Annual Weekday Traffic Reports (AAWDT)) on major roadways are[4]:

1. Quesnel Bridge 116,700
2. Yellowhead Trail West of 231 Street 112,600
3. Anthony Henday Drive West North of Whitemud Drive 109,400
4. Anthony Henday Drive West North of 87 Avenue 103,800
5. Whitemud Drive North of 53 Avenue 99,600
6. Whitemud Drive West of 122 Street 99,000
7. Whitemud Drive South of 53 Avenue 96,900

[3] From Bureau of Aircraft Accidents Archives - https://www.baaa-acro.com/city/edmonton?page=1
[4] From City of Edmonton Transportation Data - https://www.edmonton.ca/transportation/transportation-data.aspx

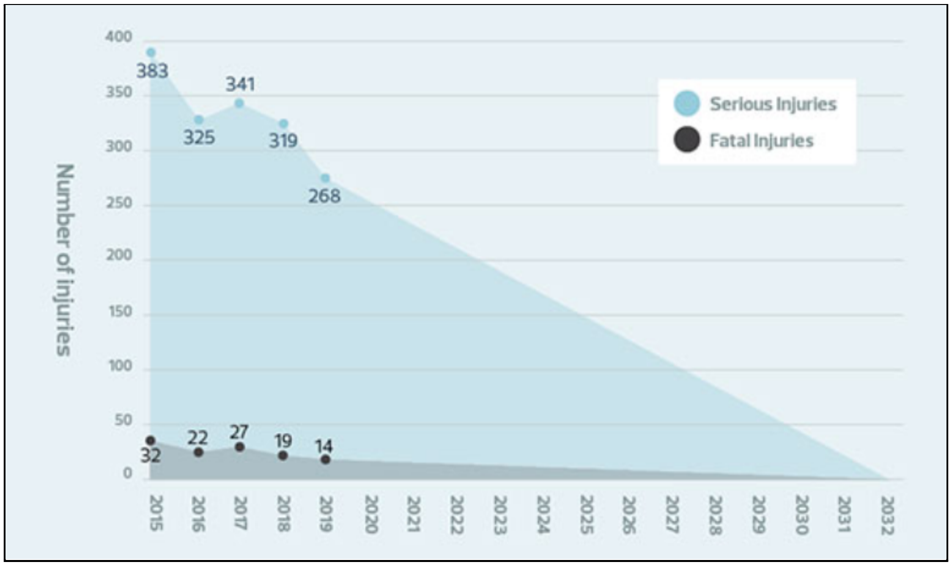
8. Whitemud Drive West of 111 Street 95,600
9. Whitemud Drive West of 91 Street 94,600
10. Whitemud Drive West of 106 Street 93,600
11. Anthony Henday Drive South West of 111 Street 91,300
12. Anthony Henday Drive West North of Stony Plain Road 90,300
13. Anthony Henday Drive West of 127 Street 90,100
14. Anthony Henday Drive North of Callingwood Road 89,800
15. Whitemud Drive West of Calgary Trail 89,100

2015 data provides a summary of percentage of weekday traffic by time of day[5]:



Since 2015, fatalities have decreased by 56% and serious injuries have declined by 30%. Recent motor vehicle collision data and forecasts[6]:

[5] Traffic Flow Map 2015 (AAWT) - https://www.edmonton.ca/transportation/RoadsTraffic/Flow_map_2015_AAWDT.pdf
[6] Office of Traffic Safety: Vision Zero Data - https://www.edmonton.ca/transportation/traffic_safety/motor-vehicle-collisions.aspx



Top ten highest collision locations (2019) in Edmonton[7]:

1. Yellowhead Trail NW & 149 Street NW 98
2. 107 Avenue NW & 142 Street NW 92
3. Yellowhead Trail NW & 97 Street NW 79
4. Yellowhead Trail NW & 127 Street NW 67
5. 23 Avenue NW & 91 Street NW 61
6. 34 Avenue NW & Calgary Trail NW 59
7. 118 Avenue NW & 97 Street NW 58
8. 34 Avenue NW & 91 Street NW 57
9. 118 Avenue NW & Groat Road NW 55
10. 153 Avenue NW & 97 Street NW 53

Rail Accident

Major railway accidents have occurred throughout Alberta and Canada in more recent times, main derailments such as the Lac-Mégantic disaster on July 6, 2013 demonstrated the devastating impact of such accidents. The derailment caused fire and explosions that destroyed half of the town of Lac-Megantic and killed 47 people. On September 18, 2013, a Via Rail train collided with a double-decker city bus at a level crossing in Ottawa, killing 6 people and injuring 35 people.

Main accidents of note are:

Date	Major Events
August 4, 2005	Lake Wabamun train derailment of 43 cars spilling up to 1.3 million litres of oil.
May 4, 2010	Via Rail train crash at the Winterburn Road and 111 Avenue NW crossing struck a pick-up truck killing 3 people.
June 23, 2011	CN freight train derailment of 3 cars near the 50 Street overpass in a

[7] Office of Traffic Safety Open Data Portal - https://www.edmonton.ca/transportation/traffic_safety/motor-vehicle-collisions.aspx

	collision with a stationary freight train.
October 19, 2013	CN freight train derailment of 13 cars west of Edmonton in Gainford caused an explosion and fire due to crude oil and liquefied petroleum gas.
November 3, 2013	CN freight train derailment of 13 cars west of Edmonton, no spills or environmental damage occurred.
July 6, 2016	Freight train collision at the Fort Road and 153 Avenue crossing with a car.
December 9, 2019	CP freight train derailment of 34 cars east of Saskatoon near Guernsey, Sask caused a fire and a spill of 1.5 million litres of crude oil.
February 6, 2020	CP freight train derailment of 19 cars again near Guernsey, Sask caused fire and a spill of approximately 1.2 million litres of crude oil (only 10 km apart from the December 9, 2019 accident).
March 9, 2020	CN freight train collision with propane tank truck at a crossing, in the hamlet of Swalwell northeast of Calgary, causing spills.
January 26, 2021	Freight train collision at a crossing east of Leduc with a car.

Train accident data for Alberta from 2008-2018[8].

Type of Accidents	Average Number of Accidents
Main-Track Derailment	20
Non-Main-Track Collision	24
Non-Main-Track Derailment	118
Crossing Accidents	40

The City of Edmonton is serviced by a number of commercial rail lines: Canadian National (CN), running east/west and paralleling the Yellowhead Freeway; Canadian Pacific (CP), which enters the city from a north/south direction; Rail Link, which is "short line" track system that serves the north.

Various commodities are shipped by rail to and through Edmonton on a yearly basis and range from automobiles to grain to a number of chemicals and fuels. On a kilometre by kilometre basis, rail mode is considered to be much safer than road mode. In the City of Edmonton, commercial rail lines adhere to strict rules set forth by Transport Canada. Transport Canada updated reduced speed limits for freight trainings on November 6, 2020, in response to increased risk of derailment accidents[9].

Since 1978, Edmonton has had a light rail passenger transit system (LRT). Currently there are approximately 19.4 km of track operating via the Capital Line (north east to south) and the Metro Line

[8] Transportation Safety Board of Canada Data - https://www.tsb.gc.ca/eng/stats/rail/2018/sser-ssro-2018.html
[9] Transport Canada - https://www.canada.ca/en/transport-canada/news/2020/11/minister-of-transport-issues-revised-order-to-improve-rail-safety-in-the-winter.html

(to the north west). Completion of the Valley Line track will add another 27 km to the south east of Edmonton. In 2019, approximately 113,804 passengers ride the LRT daily. There are currently 18 controlled roadway crossings and historically low volume of incidents have been experienced involving LRT trains.

Edmonton Transit is a member of the American Public Transit Association (APTA) and prescribes to their Rail Safety Management Program. This program provides an independent system safety audit of the LRT system on a regular basis. LRT also has established rules, policies and standard operating procedures in place to reinforce safe practices.

Atmosphere

Climate change impacts are being experienced around the world. In Edmonton, there are still four distinct seasons but weather extremes and weather counter to normal averages have been experienced more in recent years. Overall unpredictable weather, be it extreme or mild, has started to become more of the normal compared to historical records. This unpredictability provides the support for robust emergency planning.

Blizzards (Snow)

A severe winter storm or blizzard occurs when heavy snowfall is accompanied by strong winds, blowing/drifting snow, and decreasing temperatures.

Date	Major Events
1903	Blizzard stranded thousands. Bright sunlight reflecting from the snow left livestock and humans snow blind.
November 1942	Blizzard with 19.5 inches (49.53 centimetres) of snow derailed seven streetcars and delayed milk and bread delivery. Snow drifts 36 inches deep (91.44 centimetres). Snowplow equipment available in southern Alberta was sent to Edmonton.
November 14, 1944	Winter storm closed trails in outlying areas preventing coal delivery.
April 20, 1955 (spring)	16.5 inches (41.9 centimetres) of snow broke the previous record for April.
October 4, 1957	One of the worst October blizzards on record.
December 14-16, 1964	Full-scale blizzard warning issued. Four people died.
April 22, 1972 (spring)	Six inches (15.24 centimetres) of wet, sticky snow downed power lines leaving parts of the city without power for up to 12 hours.
December 6, 1979	Storm downed power lines leaving many residents without power for 40 minutes.
January 15–19, 1982	Blizzard with -30°C weather resulted in an 11-car pile-up. Broken water mains flooded the streets.
January 20, 1982	Severe cold resulted in two deaths from hypothermia. Water mains

	broke and schools closed while periods of ice fog made driving difficult. The cost of clean up was $1.7 million as 45.3 centimetres of snow fell in the first 19 days in January
May 20, 1989 (spring)	15 centimetres of wet, heavy snow snapped trees and caused 100 power outages.
May 21, 1997 (spring)	Storm left 25,000 without power, broke 16,000 trees, damaged buildings, and caused major problems on highways.
March 22, 2013	A snow storm resulted in a 100 car pile-up just south of Edmonton on Hwy 2. 3 people were killed, 80 people were treated on scene, and an additional 22 people had to be taken to hospital. RCMP were overwhelmed and multiple resources from Edmonton were required.

There are many factors that can affect the impact of a winter storm other than the amount of snow received. They include the speed of the prevailing winds (drifting), freezing rain (prior to snowfall), and the time period of the snowfall. Generally, significant snowfall over a short period of time affects the city's ability to react to and manage the situation more than snow falling at a slower consistent rate, but both scenarios have the potential to cause their own unique problems.

During a major snowfall, the City enforces parking bans on main routes to allow for snow removal. The City of Edmonton has a proactive and updated snow and ice removal plan that is frequently updated for continuous improvement.

Hail

When winter precipitation falls as freezing rain or drizzle, heavy ice accumulations (ice storms) can cause significant damage, especially when accompanied by high winds.

Hail forms in the cores of thunderstorms. Water vapour in warm, rapidly rising air masses (convection currents) condenses into water at higher, cooler altitudes, producing heavy rain showers. If it is cold enough, ice crystals can form around minute particles, such as dust whipped up from the ground. These increase in size as more water freezes to their surfaces. When the ice pellets are too heavy for the ascending air currents to lift, they fall as hail. They may become larger, heavier and more damaging if they collect more water on the way down. Damage from hail can have devastating effects in the way of flattening crops and gardens, stripping trees and plants of foliage, damaging roofs and other property damage, and creating icy roadways which can cause treacherous driving conditions.

Edmonton's climate is such that during the most likely periods for ice storms,there is very little moisture in the air. Due to this unique fact, it is not uncommon for hail storms to occur over summer months and cause devastating damage. There are times, however, when freezing rainfall will dramatically affect traffic flow for several hours as well as cause hazards for pedestrians.

During the early morning of May 21, 1997 Edmonton experienced a significant cold snap and steady, wet snow fell. Edmontonians woke up the next morning to snapped power lines and damaged trees. Traffic disruptions were widespread as numerous roadways were impassable and many traffic lights inoperable. While power restoration was an immediate priority, total clean up of tree debris took three days. Storm costs were estimated to be nearly $1.2 million and many trees needed replacement in the following months.

Not all hailstorms are widespread. In Edmonton many areas can experience a hailstorm while at the same time other areas in the city remain unaffected. Other than the hail preceding the devastating tornado that hit Edmonton on July 31, 1987, hailstorms causing significant property damage in the last 20 years have been:

- July 1993 Estimated damage $21 million
- July 1995 Estimated damage $34.5 million
- July 11, 2004 Estimated damage $87 million (grape fruit to golf ball sized hail)
- July 12, 2010 In Calgary, estimated damage $400 million
- August 12, 2012 In Calgary, estimated damage $552 million
- August 2, 2019 Estimated damage $90 million (grape fruit to golf ball sized hail)
- June 13, 2020 In Calgary, estimated damage $1.2 billion

Extreme Cold

Being the most northern major city at 53 degrees north latitude, Edmonton has the potential for facing more severe winter weather related hazards. At times, the temperatures will drop dramatically. On November 6, 1962 the temperature dropped 25° from -0.5°C to -26°C in only 32 hours. The historic record low for Edmonton is -48.3°C. Edmonton historically experiences about 25 days a year with -20°C and 3 days a year with -30°C (with 3 days of -40°C with wind chill)[10].

In winter, one of the greatest, most consistent factors that must be dealt with is the cold. In times of extreme cold, machinery breaks or malfunctions, vehicles fail to start, water lines freeze and burst causing flooded streets that turn into sheets of ice. Current challenges with vulnerable people experiencing temporary homelessness has highlighted the importance of extreme weather response from the city through existing plans with social agencies.

Extreme Heat

Edmonton also experiences extreme heat warnings over summer months. A Historic high temperature of 34.9°C was reached on June 26, 2002. On average, Edmonton has experienced temperatures above 30°C four days per year[11]. The most recent occurrence of extreme heat warnings were in July 2019 as warnings were issued for most of Alberta. The city's extreme weather response plan was also updated in 2019 to incorporate responses for both extreme cold and heat scenarios to protect vulnerable people and the public.

Tornado

A tornado is a violent funnel shaped, destructive, rotating column of air with wind speeds that can exceed 511 km/h (300 mph). Path widths can range from a few metres to over 1.3 kilometres. Average forward speed is 40 km/h (25 mph) but can exceed 130 km/h (80 mph).

Tornadoes are classified according to the Fujita F-Scale of Severity:

- F-0 (64-116 km/h) - light damage (broken branches, etc.)
- F-1 (117-180 km/h) - some minor roof damage (can overturn mobile homes)
- F-2 (181-252 km/h) - strong (can remove a roof or demolish a mobile home)

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[10] Government of Canada Climate Data - https://climate.weather.gc.ca/climate_normals/results_1981_2010_e.html?searchType=stnName&txtStationName=edmonton&searchMethod=contains&txtCentralLatMin=0&txtCentralLatSec=0&txtCentralLongMin=0&txtCentralLongSec=0&stnID=1867&dispBack=0

[11] Government of Canada Climate Data - https://climate.weather.gc.ca/climate_normals/results_1981_2010_e.html?searchType=stnName&txtStationName=edmonton&searchMethod=contains&txtCentralLatMin=0&txtCentralLatSec=0&txtCentralLongMin=0&txtCentralLongSec=0&stnID=1867&dispBack=0

- F-3 (254-331 km/h) - severe damage
- F-4 (332-418 km/h) - devastating damage
- F-5 (419-511 km/h) - incredible damage (very rare)

Date	Major Events[12]
July 8, 1949	“Baby” tornado touched down on the outskirts of Edmonton but did little damage.
July 18, 1962	Storm with tornadoes and hail injured two people, flooded the exhibition grounds, and cut electrical service in many areas.
July 31,1987	An F-4 tornado had devastating effects upon property, human life, and resources. Dubbed "Black Friday" by the media, a total of 27 people were killed, the majority being from the Evergreen Mobile Home Park. Property damage in Edmonton and in the surrounding jurisdictions was estimated in excess of $360 million.
July 28, 1989	Edmonton again had a small tornado touch down in the west, injuring two people and causing $500,000 in damages
June 29, 1998	Tornado touched down in Tofield, Alberta south east of Edmonton.
July 14, 2000	Although the "Pine Lake" tornado in the County of Red Deer had no major impact on Edmonton, City personnel were dispatched to assist.
August 7, 2000	A pilot near the community of Millwoods reported seeing a tornado touchdown.
July 11, 2003	A tornado touched down near Westlock County north of Edmonton.
August 12, 2003	A tornado reportedly touched down west of Wabamun. Environment Canada issued tornado warnings for Villeneuve and St. Albert.
July 11, 2004	Tornado warnings were issued for areas west of Edmonton in Lac Ste. Anne and Mayerthorpe.
July 29, 2006	A severe thunderstorm warning with potential to produce a tornado was issued for the Edmonton region.
June 5, 2007	A tornado touched down just south of Stony Plain.
July 8, 2007	A tornado touched down south of Mayerthorpe north of Edmonton.
July 23, 2007	A tornado touched down south of Highway 2/2A junction in Leduc County.
June 10, 2008	A tornado touched down near Wabamun west of Edmonton.
July 16, 2008	A weak F0 tornado touched down briefly just north of downtown Edmonton.
July 24, 2019	Two tornadoes reportedly touched down near Waskatenau north of

[12] Government of Alberta, Alberta Emergency Management Agency Public Warning - Historic Activation.

	Edmonton.

Aftermath of "Black Friday Tornado - July 31, 1987:

(Tornado photos by Bill Cattroll, City of Edmonton)

On average there are 15 tornadoes reported in Alberta per year[13]. The other Canadian “hot spot” for tornadoes is southwestern Ontario. Canada is second in the world to the United States for frequency of tornadoes.

Environment Canada, through the Prairie and Arctic Storm Prediction Centre, operates out of Edmonton and Winnipeg to issue public broadcasts, weather watches, and warnings for the prairies and northern territories. The centre has expertise in predicting severe weather and consolidates efforts previously carried out by facilities located in several locations across the prairies. Using specially trained warning preparedness meteorologists, the centre has an important training and educational role with schools, emergency response organizations, and media.

Dangerous Goods/ Hazardous Materials

As identified in the Transportation of Dangerous Goods Act and Regulations, a dangerous good is *"any article or substance that is capable of posing significant risk to health, safety or property when transported."*

The Act provides for nine classifications of dangerous goods (also known just as "DG" or hazardous materials), sets the standards for the safe movement of these materials and identifies the documentation required; safety marks (labels/placards) and training requirements. In addition, the Act specifies emergency incident reporting criteria and the circumstances when specific emergency response plans are required.

Transportation of Dangerous Goods Act and Regulations classification system:

Classification	Description

[13] The Weather Network website - https://www.theweathernetwork.com/ca/news/article/one-province-has-a-big-lead-in-canadian-tornado-stats-for-summer-2019

Class 1	Explosives
Class 2	Gases
Class 3	Flammable liquids
Class 4	Flammable solids; substances liable to spontaneous combustion; substances which, in contact with water, emit flammable gases
Class 5	Oxidizing substances and organic peroxides
Class 6	Toxic and Infectious substances
Class 7	Radioactive material
Class 8	Corrosive material
Class 9	Miscellaneous hazardous substances

In Edmonton and in the surrounding communities, high volumes of various dangerous goods are produced or shipped to, or through Edmonton, by rail or road on an annual basis. These commodities, in the majority, are manufactured or reach their destination without incident. However, mishaps do occur. The City of Edmonton has a well-trained Dangerous Goods Response Team. As well, the city is represented on a number of industry specific safety committees (i.e. Canadian Chemical Producers Association, Strathcona Industrial Association (SIA), Edmonton Area Pipeline and Utility Operators Committee (EAPUOC)).

Not all dangerous goods are industrial or commercial, common household items are also considered dangerous goods. Cleaners, bleaches, disinfectants, aerosols, gasoline/petrol, camping fuel, solvents, paints, pesticides, and weed killers are all considered to be dangerous goods. All dangerous goods require hazard labels, instructions for proper safe use, and safe disposal instructions. Alberta Transportation and Utilities has a number of Dangerous Goods Inspectors who regularly monitor dangerous goods/hazardous materials manufacturing and storage facilities.

A Dangerous Goods Spill is the accidental release of chemical, biological, or radiological material during transportation or handling at a fixed site. Under the Alberta Environmental Protection and Enhancement Act *“a release includes to spill, discharge, dispose of, spray, inject, inoculate, abandon, leak, seep, pour, emit, empty, throw, dump, place & exhaust” of a substance that causes the “impairment of or damage to environment, human health or safety of property”.*

In 1980, the federal government passed the Transportation of Dangerous Goods Act (TDGA). This act promotes public safety when transporting dangerous commodities including chemicals. It applies, with specific exceptions, to all handling, offering for transport, and actual carrying of dangerous goods in Canada irrespective of their point of origin, destination, or means of conveyance.

On September 5, 1980, a system of dangerous goods transportation routes was proposed and implemented shortly thereafter. In July, 1985, the first regulations under the TDGA came into force and applied to all modes of transportation. On February 5, 1987, the Edmonton Fire Rescue Service placed the first fully trained and equipped Hazardous Materials (Dangerous Goods) Team into service. The team continues to evaluate and monitor the potential need for expansion of a second team to cover north and south Edmonton[14]. The teams respond to support the nearest fire pumper unit. The teams also support smaller communities in central and northern Alberta.

A classification system has been established for response to dangerous goods incidents. Each level of response requires different levels of resources to effectively correct or deal with a situation, as shown on the next page:

Classification	Description
Minor Spill	A minor spill (less than 5 litres) involving any class of dangerous goods transported or storage systems.
Small Spill	A small spill (5-24 litres) involving any class of dangerous goods transported or storage systems.
Large Spill	A large spill (25 or more litres) involving any class of dangerous goods transported or storage systems.

Sub Classification	Description
Natural/ LP Gas Storage Tank	• Large tank is greater than 2200 litres • Small tank is less than or equal to 2200 litres
Chemical Storage Tank	• Large tank is greater than 2200 litres • Small tank is less than or equal to 2200 litres
Fuel Storage Tank	• Large tank is greater than 2200 litres • Small tank is less than or equal to 2200 litres

Most incidents of chemical and other toxic material accidentally released in Edmonton have been of a minor nature consisting of spills of less than 20 litres. Should a spill occur in the North Saskatchewan River, the City would coordinate with EPCOR the immediate shut-down of water treatment plant intakes in order to mitigate impact to the plants, and the drinking water supply. Should the event be severe enough to impact the drinking water supply, the City has several reservoirs throughout the City and will coordinate with EPCOR and the Province to implement water conservation measures, to use water from non-impacted areas of the system, and to implement the Emergency Drinking Water Supply Plan to source water from outside the City.

Hazmat (Fixed Site) - Pipeline/ Storage Facility

Dangerous Goods storage constitutes large quantities of stored chemical, biological and radiological materials at a fixed site. Accidents or leakage can result in a threat to life and property, or contamination of the environment.

Chemical distributors, storage, and manufacturing facilities within Edmonton are very fastidious regarding ongoing training of staff and maintaining high levels of monitoring of all aspects of their operation for hazardous incidents. These facilities hold joint training sessions with EFRS and EMS personnel to maintain awareness and skill levels.

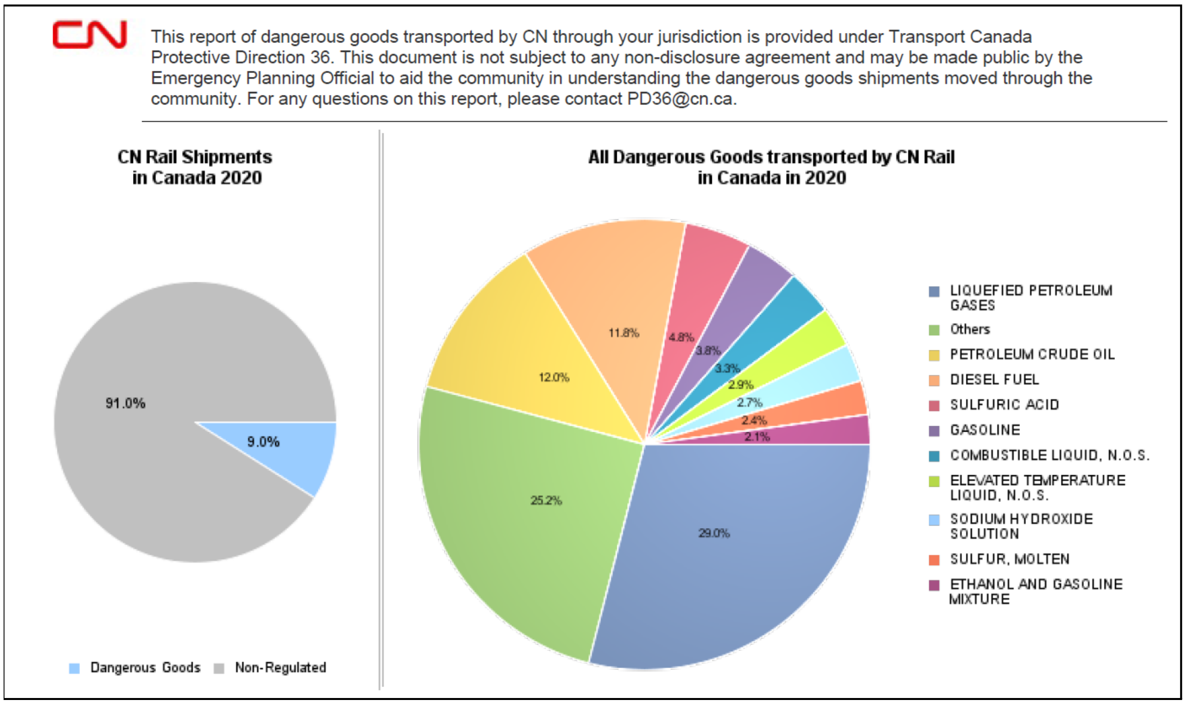
[14] For information Council Report 3201 presented on June 20, 2016 (CR_3201) on potential requirements for expansion of the Hazardous Materials (Dangerous Good) Team.

Programs such as the City of Edmonton's Fire Inspection Service and the Provincial Dangerous Goods Inspections also serve to ensure that fire protection systems are in good working order and that dangerous commodities are stored and handled in a safe manner.

**Pipeline spill and hazmat - refer to assessment of risk under Explosions and Emissions section.*

Hazmat (Transportation) - Rail
Rail transportation of materials and goods continues to be a key part of movement of goods all across Canada. In Alberta, the transportation of crude oil based products continues to be a major channel for moving crude oil, natural gas and petroleum based products to market around North America. CN reports transportation of dangerous goods to Transport Canada under Protective Direction 36[15].

CN dangerous goods shipped in Canada 2020:



CN top dangerous goods shipped in Edmonton 2020:

[15] CN Reporting of Dangerous Goods in Canada and Edmonton 2020 - https://mft.cn.ca/pkg?token=bb93f040-f228-4205-afe6-842df287b3c0#

2020 Dangerous Goods Shipments in:
Edmonton,AB (4811061)

These top 10 products comprise 86% of the dangerous goods shipments in this Municipality.
The remaining 14% are many different products, each comprising less than 1% of the total.
Dangerous Goods shipments account for 7.46% of the total shipments in this Municipality.

	Proper Shipping Name	% of DG Shipment Locally
1	LIQUEFIED PETROLEUM GASES	28%
2	PETROLEUM CRUDE OIL	22%
3	DIESEL FUEL	20%
4	SULFUR, MOLTEN	4%
5	ELEVATED TEMPERATURE LIQUID, N.O.S.	3%
6	SODIUM HYDROXIDE SOLUTION	2%
7	HYDROCARBONS, LIQUID, N.O.S.	2%
8	GASOLINE	2%
9	PETROLEUM DISTILLATES, N.O.S.	2%
10	ELEVATED TEMPERATURE LIQUID, FLAMMABLE, N.O.S.	1%
11	Others	14%

Hazmat (Transportation) - Road
Designated routes through the primary industrial areas, there are secondary routes where dangerous goods loads are transported. Hundreds of loads of dangerous goods are transported daily through the city by truck. Loads can be large quantities of individual products or mixed loads that, in the event of an accident, can lead to deadly consequences.

Notable dangerous goods incidents:

Date	Major Events
September 21, 1978	A gasoline tanker spilled 39,550 litres of gas into the sewer system at 98 Street and 85 Avenue. Forty homes were evacuated, natural gas was shut off, and crews extinguished two flash fires in the sewer.
April 17, 1980	270 litres of 2-4D spilled at 125 Avenue and 82 Street.
May 20, 1981	34,000 litres of gasoline and diesel spilled and caught fire at 92 Avenue and 39 Street when a truck and train collided.
May 19, 1982	38 rail cars carrying sulphur residue caught fire at the Calder Yards creating a potentially hazardous toxic gas.
June 21, 1989	A 22-litre pail of dimethylaniline spilled near a school at Wagner Road and 86 Street. Seven people were admitted to the University of Alberta Hospital complaining of headaches and nausea.
June 27, 1996	Aqua ammonia release in the Millwoods Recreation Centre sent a number of patrons and staff to hospital.
July 9, 2001	A cloud of unknown substance at the Waste Recycling Centre at Clover Bar. The Dangerous Goods Team could find no trace of the substance but several staff members required medical attention.

July 20, 2016	A Husky pipeline spilled 225,000 litres (1400 barrels) of heavy crude oil and other fluids into the North Saskatchewan River near Maidstone, Saskatchewan. Although this was not near Edmonton, the spill impacted many towns and cities located downstream along the river.
August 18, 2019	Bonterra Energy Corp pipeline spills 40,000 litres of oil into Washout creek, which flows into the North Saskatchewan River. No contamination was reported to drinking water
December 25, 2020	ARC Resources Ltd pipeline spills about 400 cubic metres or 2,500 barrels of contaminated salty water into the North Saskatchewan River outside of Drayton Valley. No contamination was reported to drinking water.

Dangerous Goods incidents tracked by EFRS:

Year	2012	2013	2014	2015	2016	2017	2018	2019	2020
# Events	647	731	771	872	2170	1999	1894	1794	1261

Diseases and Epidemics

Human Health Emergency

A public health threat is a medical, health, or sanitation occurrence such as contamination, epidemic/pandemic, or infestation that poses a threat to the general public.

Edmonton is as vulnerable to a major health threat as any Canadian city its size. Increasing travel and mobilization of populations as well as increased imports, also increases the chances of swift transmission of human-borne diseases. However, the probability of a major health threat occurring is difficult to predict. COVID-19 certainly proved that the world was not ready for this global pandemic.

In spite of this, Edmonton is as prepared as it can be to withstand a public health issue:

- Alberta Health Services (AHS) is Canada's first and largest province-wide, fully-integrated health system, responsible for delivering health services to nearly 4.4 million people living in Alberta.
- A single provincial health organization offers integrated and system wide response for frontline care and logistics.
- Edmonton Zone consists of 14 hospitals and 32,657 AHS employees supporting the healthcare system.

Historic public health threats:

Date	Major Events
1892	Smallpox. Health officers inspected incoming trains and placed restrictions on travel from infected areas. Infected households quarantined. Led to the creation of the first Board of Health on July 23, 1892. During 1908-1911 there was obligatory smallpox vaccination for all school-aged children.
1911-1913	Scarlet Fever endemic. Vigorous campaign to educate housewives on disease transmission and how to "swat flies."

1912-1913	Measles epidemic.
1912	Typhoid fever outbreak (264 cases). Filtration and chlorination of the north side water plant and completion of the south side water treatment plant helped to prevent future outbreaks.
1918	Spanish Flu (H1N1 influenza A virus). In two weeks 337 people were hospitalized and 1,926 were confined at home. A preventive approach adopted by arbitrarily closing public facilities including schools, large indoor social functions, and churches. Stores and offices could only open between 10:00 a.m. and 3:00 p.m. These efforts proved futile, so the Board of Health began treating the disease. By May 1919, 8,000 people out of 60,000 had influenza: 615 died.
1918-1920	Scarlet fever. Cases rose from 98 to 623.
1919-1921	Smallpox.
1925-1927	Polio. Twenty-three deaths plus numerous cases of paralysis.
1927	Smallpox. Fifty-four cases (all but three had not been vaccinated). Twelve thousand residents were immunized in a few weeks.
1932	Measles.
1952-1953	Polio. In 1953 there were 322 cases and 33 deaths. Salk Vaccine introduced in 1954. All Grade 1 children were vaccinated in 1955.
1957	Asian flu.
1962	Measles: 2,817 cases. Immunization against measles began in 1966 and the number of cases dropped dramatically.
1968	Hong Kong flu.
1979	Measles: 2, 012 cases.
1982–1983	Hydrogen sulphide gas leak at Lodgepole (respiratory problems).
1982	Giardiasis outbreak linked to North Saskatchewan River water: 895 cases.
1986	Flooding of North Saskatchewan River (considered a public health threat due to contaminants/residues left behind after the water receded. Public Health issues information bulletins in these circumstances for such things as cleaning carpets, floors, walls, etc.).
1990	Pertussis (whooping cough): 615 cases compared to 66 the previous year.
1997	Measles: 120 cases
1999-2001	Meningococcal disease: 60 cases
2002-2004	SARS coronavirus epidemic (Severe acute respiratory syndrome) began in south China and eventually spread to different parts of the world. SARS was first identified in Toronto on February 23, 2003, this led to 44 deaths (251 reported

	cases). Although SARS was contained mostly to Toronto, screening was conducted at both Toronto and Vancouver international airports. Quarantine and isolation was used to curb the spread of the disease.
2009-2010	Swine flu pandemic (H1N1 influenza virus - H1N1pdm09), originating in Mexico and was confirmed in Canada with 45,771 cases and 505 deaths in 2008-2010. There were approximately 1276 hospitalization cases, 71 deaths and 5337 non-hospitalized cases in Alberta during 2009 and transmission originated from farmers traveling from Mexico via contact with infected pigs.[16]
2019- *tbd*	COVID-19 (coronavirus SARS-CoV-2) is the first major global pandemic since the 1918 Spanish Flu. Originating in Wuhan, China with the first case identified in December 2019. COVID-19 has spread globally with 111,102,016 confirmed cases and 2,462,911 deaths (reported by the WHO as of Feb 22, 2021)[17]. Canada has 845,925 confirmed cases and 21,690 deaths; while Edmonton had 53,180 confirmed cases and 951 deaths (as of Feb 22, 2021)[18]. This is an ongoing pandemic and many lessons learned will be taken for future response plans.

Vaccination campaigns:

Date	Major Events
1976	Swine flu - 70,000 vaccinated.
1979	Measles - 1,738 vaccinated.
1997	Measles - 93,750 vaccinated.
2000-2001	Meningococcal disease - 230,000 vaccinated.
2010	Swine flu (pH1N1) vaccine administered to 1,310,085 Albertans.
Every year	Influenza vaccination campaign.
Every year	Grade 5 Hepatitis B vaccination.
Catch-up program	Grade 12 Hepatitis B vaccination.
2021 - tbd	Covid-19 Vaccination campaign started January 2021.

Agriculture Plant Disease/ Pest Infestation

Due to the expansion of globalization in travel and trade, plant disease and pest infestation has become more common across North America.

The City's Pest Management Strategy is based on scientific expertise and environmental stewardship through the adoption of integrated pest management principles. Integrated Pest Management (2019) is a multidisciplinary, ecological approach to the management of pests based first on prevention and,

[16] AHS Report - Pandemic (H1N1) 2009: The Alberta Experience - https://www.albertahealthservices.ca/poph/hi-poph-surv-h1n1-ab-experience-2009.pdf
[17] World Health Organization (WHO) Covid-19 Dashboard - https://covid19.who.int/
[18] AHS Dashboard Report - https://www.alberta.ca/covid-19-alberta-data.aspx

when necessary, control. Integrated Pest Management incorporates effective, economical and environmentally sound methods and strategies that include:

- Preventative/Cultural Measures
- Biological and Mechanical Controls
- Chemical Controls

Mosquito-borne diseases such as West Nile virus have now been reported annually across Canada since 2002. Although mosquito-borne diseases like West Nile, Zika and Asian tiger mosquitoes are gaining more coverage and risks, they are more prevalent in warmer climates. Further risk of human disease transmission by local mosquito species has lowered since outbreaks of Western Equine Encephalitis in central Alberta in the 1930s that caused horse and human deaths.

Warmer seasonal weather and wetter summer months of June and July typically produce heavy nuisance mosquito activity in the Edmonton region. Invasions of mosquitoes regularly pose serious annoyance, which curtails many outdoor activities. The build-up of nuisance mosquito populations which breed quickly in more temporary standing water bodies over the land follows cycles in the availability of wetter conditions.

The City of Edmonton mosquito abatement program provides an organized approach to the suppression of mosquito biting while reducing exposure of citizens to chemical insecticides. The program monitors the mosquito species that are competent disease vectors and delivers effective control of aquatic developmental stages of those species that cause annoyance.

Invasive pest species provide more of a threat to our environment but could have potential to cause harm to humans if not monitored and controlled. Non-native pests are less likely to resolve naturally. This can have more harmful or sometimes serious consequences on tree and native vegetation survival. Organizations like Alberta Invasive Species Council, established in 2006, work to identify and educate on threats of invasive species. Recent incidents have even involved seeds being sent through Amazon from China as part of an online consumer scam, but these invasive species could cause damage if planted and introduced to our native vegetation.

Federally quarantinable pests like the emerald ash borer, Asian gypsy moth or the Asian long-horned beetle are examples that warrant emergency measures due to the environmental destruction these species will cause if left unchecked. The status of federally quarantinable pests is assessed through the use of monitoring devices and inspections conducted under the auspices of the Plant Protection Act. Typically the presence of these insects in Edmonton would generate resource assistance from provincial and federal agencies under the Critical Pest Infestation Response Plan if local government resources were insufficient to eradicate the problem. Emerald ash borer in particular threatens over 88,000 publicly owned ash trees in Edmonton, worth over $100 million, and an unknown number of private trees. In Michigan where it was first discovered in North America in 2005, it has wiped out over 99% of all ash trees. In Canada it has since spread to five provinces.

The Provincial mandatory boat inspection program for eliminating invasive zebra mussels also works to prevent infestation. As well as the province's tracking of the mountain pine beetle across Alberta as the beetle presents threats from BC across to AB.

Plant diseases such as Dutch elm disease (DED) threatens 70,000 elms planted on public and private property throughout Edmonton. This non-native disease has ravaged American elm populations throughout the United States, and south central and eastern Canada. Winnipeg is an example of how devastating DED can be to an urban forest. Although Alberta is still mostly disease free, the beetles, which carry the disease, have been found in Edmonton and St. Albert (since 1995), Calgary (since 1994), and Vauxhall (since 1996). Since then, they've been found across the province, from Medicine Hat to Grande Prairie. In other areas, DED arrived three to seven years after the first detection of elm bark beetles. The disease and its vectors are regulated pests under the provincial Alberta Agricultural Pest Act. Two trees with Dutch elm disease were identified in Lethbridge in 2020.

Along with furthering a number of strategies to prevent the disease, the City of Edmonton's Community Standards Bylaw (14600) provides controls on pruning activities to prevent potential for spreading . Public education on the bylaw and the disease itself is coordinated through the city's Pest Management team. Monitoring of elm bark beetle populations and elm wilt disease symptoms in Edmonton provides an early warning system for this devastating condition.

Explosions and Emissions

The Edmonton region has continued to develop into a hub for many large industrial facilities such as the Shell Scotford Complex. The most major development was the launch of the Sturgeon Refinery in December 2017. Phase one now produces 79,000 barrels per day of diluted bitumen from Alberta's oil sands just 45km northeast of Edmonton. Existing infrastructure such as Shell Sherwood Terminal, Suncor Refinery and Kinder Morgan Terminal all align to the eastern edge of Edmonton. Additional assets in manufacturing and industrial processing provide products from cement to chemicals, cellulose fibres to petroleum and natural gas; these huge plants are made up of a sophisticated network of pipes, pressurized chambers and vessels, gauges, control panels and other related systems. The prairie landscape continues to be dotted with oil and gas pumps, controlling the flow of product.

These types of facilities and the oil and gas industry are heavily regulated by the federal and provincial governments to ensure the safety of the public and the environment. But the preparation for an emergency response is something that requires focus from the City of Edmonton to ensure public safety can be maintained if an incident were to occur.

Explosions can occur in all settings industrial, commercial or residential. Proper emergency planning is required for all scenarios as Edmonton has experienced a variety of incidents (not specific to only industrial causes).

Some significant explosions in Edmonton:

Date	Major Events
May 1968	Natural gas explosion at the Dunston Apartments (12629 Stony Plain Road) left nine injured and two dead.
March 2, 1979	A construction excavator nicked a high-pressure pipeline in Mill Woods, prompting a gas leak, an explosion and the evacuation of 19,000 residents in the community.

April 1980	Explosion at the Boardwalk sent 10 firefighters to hospital.
September 1980	25,000 gallons of methanol gas exploded at the Turbo Refinery sending flaming debris 200 metres into the air.
April 1982	Explosion at the CIL Plant (44 Street and 101 Avenue - now AT Plastics) was heard and felt 30 kilometres away.
July 1989	Gas explosion in Holyrood (7912-93A Avenue) damaged 35 homes and killed one person.
June 21, 2010	Explosion at northeast house resulting in three dead.
July 26, 2011	Explosion at a southside home near King Edward Park (83 Street and 80 Avenue).
November 27, 2013	Explosion at Clean Harbors, in Leduc industrial area south of Edmonton, when two workers were flushing out a tanker trailer unit in a wash bay that had petrochemical products in the tank previously.
December 3, 2018	Explosion at northside home (120 Avenue and 102 Street).
June 23, 2020	Explosion at downtown apartment building (106 Avenue and 108 Street).
July 20, 2020	Multi-suite home explosion near Commonwealth Stadium (112 Avenue and 91 Street)
August 20, 2020	Explosion at an industrial work yard east of Edmonton while a welder was working under a tanker trailer at ARS Trucking & Welding.

Chemical, Biological, Radiological, Nuclear Event
The greater Edmonton community has a number of large industrial facilities involved in the processing of chemical and petro-chemical commodities. While each of these facilities has excellent maintenance schedules and well-developed emergency response plans, incidents have occurred. In July of 1987, the Stelco steel plant (now AltaSteel) was hit by a tornado and suffered significant structural damage as well as damage to the environmental protection systems. However the situation could have been far worse as the tornado passed directly between two major refineries.

Beyond industrial accidents, the intentional cause of a biohazardous incident has become more of a credible threat in recent decades. Biohazardous materials are substances that are hazardous to humans and can include materials such as AIDS viruses, infectious samples, bacterium etc. Specialized packaging and transport requirements usually provide safe protection. If any product escapes, response mechanisms exist to contain and mitigate the effects.

An emerging area of concern is the intentional manufacture and release of biological agents such as anthrax or smallpox. The terrorist attacks of September 11, 2001 and the subsequent anthrax scares in the United States increased the number of false reports in the City of Edmonton. Any white or powdered substance created suspicion and the City of Edmonton was kept busy responding, as were numerous other North American cities. From October, 2001, to April 30, 2002, the City of Edmonton responded to nearly 100 of these types of calls. All were deemed to be innocuous substances, and to date there are still no confirmed cases of intentional biological releases or attacks in Edmonton let alone in Canada. Government officials are monitoring the situation.

Oil and Gas Emergency

An accident is the uncontrolled release of oil or natural gas, or the extremely poisonous byproduct hydrogen sulphide from production wells. Hydrogen sulfide is a naturally occurring gas mixed with natural gas or dissolved in oil or brine and is released upon exposure to atmospheric conditions.

Over the last 25 years, there have been many accidents involving sweet and sour gas wells within the city where varying amounts of product were released into the environment. One hundred and ten of the incidents involved sweet gas, and 17 involved sour gas (hydrogen sulfide).

The most recent examples of a potentially catastrophic incident occurred during fires at the Shell Scotford Complex fire on November 19, 2007 and on April 15, 2019. The fires were safely extinguished with no one suffering injuries.

The petroleum and natural gas industry is highly regulated and has a fine safety record, however the threat of accidental releases, fires, and explosions still exists. In addition to these hazards, many of Alberta’s oil and gas wells contain hydrogen sulfide. At concentrations of 700 parts per million (PPM), as little as one breath of hydrogen sulphide can kill. Although hydrogen sulphide can be detected by a “rotten egg” odor in concentrations from .03 to 150 PPM, larger concentrations paralyze the olfactory nerves so that odor is no longer a hazard indicator.

Small concentrations can cause coughing, nausea, severe headache, irritation of mucous membranes, vertigo, and loss of consciousness. Hydrogen sulphide forms an explosive mixture with air temperatures at 500°Fahrenheit (F) or above and is dangerously reactive with powerful oxidizing materials. Hydrogen sulphide can also cause the failure of high strength steel and other metals. This requires that all company and government responders be familiar not only with emergency procedures for well sites but also with the kinds of material that are safe for use in a sour gas well response.

Hydrogen sulphide concentration and symptoms:

Concentration	Symptom
10 ppm	Onset of eye irritation.
50-100 ppm	Slight conjunctivitis and respiratory tract irritation after one hour.
100 ppm	Coughing, eye irritation, loss of smell after 2-15 minutes. Altered respiration, eye pain and drowsiness after 15-30 minutes. Throat irritation occurs after one hour. Several hours of exposure results in a gradual increase in severity of these symptoms and death may occur within 48 hours.
200-300 ppm	Marked conjunctivitis and respiratory tract irritation after one hour.
500-700 ppm	Loss of consciousness and possibly death in 30 minutes to one hour.
700-1000 ppm	Rapid unconsciousness, cessation of respiration, and death.

1000-2000 ppm	Unconsciousness at once with early cessation of respiration and death in a few minutes. Death may occur even if a person is immediately removed to fresh air.

Pipelines (Hazardous Materials)

A pipeline break/release is the accidental release of substances, liquid or gaseous, transported through an underground network of medium or large diameter pipes.

Edmonton is surrounded and bisected by several pipelines. As well, a "Transportation Utility Corridor" rings the city. Major corridors cross Edmonton diagonally from 156 Street and 41 Avenue to 15 Street and 90 Avenue. Another travels along Calgary Trail north to Ellerslie Road and then diagonally from 101 Street to 34 Avenue and Whitemud Drive. Pipeline Alley, originating in Fort Saskatchewan, intersects the city at approximately 130 Avenue and the eastern city limits to 10 Street and 118 Avenue and then into Refinery Row.

Through these major pipeline corridors, there are approximately 70 pipelines varying in diameter from 80 to 864 millimetres. The lines transport a variety of products such as salt water, oil, nitrogen, hydrogen, natural gas, methanol, propane, ethane, and gasoline.

The pipeline industry in Alberta and Edmonton is tightly regulated and monitored. Oil and gas pipelines are regulated by the Alberta Energy Regulator, while utility pipelines are regulated by the Alberta Utilities Commission. As a direct result of the 1979 Millwoods pipeline disaster, the Edmonton Area Pipeline and Utilities Operators Committee (EAPUOC) was formed. EAPUOC organizes and facilitates communication among owners of buried pipelines, utility installations, emergency responders, and regulators in the event of an emergency. Each year EAPUOC organizes an emergency training exercise and safety seminar for the general public and industry. EAPUOC has grown to forty members made up from distinguished companies and reputable organizations in the Capital Region.

The Alberta Pipeline Act requires all pipeline licensees to report a pipeline failure to the Alberta Energy Regulator or Alberta Utilities Commission regardless of cause, magnitude, or consequence. Staff verifies the cause of the failure and ensures that measures are taken to reduce future failures. A percentage of new pipeline installations are inspected for compliance with appropriate codes, acts, and regulations. As well, staff conducts inspections on licensed systems to ensure that operators meet record and maintenance requirements for continuous pipeline integrity. Staff also holds awareness seminars for operators and contractors to reduce the incidents of pipeline hits, enhance public safety, and reduce environmental impacts.

One hundred metre wide protection zones surround pipelines to ensure development does not encroach on the lines[19]. The pipelines are patrolled daily within the city limits, by air or ground, to survey for encroachment, trespass, construction, or heavy equipment crossing. The most common reason for pipeline failure is third party contact such as contractors digging without contacting the pipeline owners or Alberta First Call. Alberta First Call is an agency funded by pipeline and utility

[19] As outlined in Pipeline Act, Alberta Regulation 91/2005 (current as of Dec 10, 2020) and by Alberta Energy Regulators, Manual 012.

operators and was put in place so a contractor or property owner developing a property can have the location of underground utilities and pipelines clearly marked.

Examples of pipeline failures are:

Date	Major Events
March 3, 1979	Edmonton's initial experience with a major pipeline rupture. Liquid propane entered the sewer system in the southeast part of Millwoods resulting in the evacuation of 17,000 people. Through coordinated efforts, a disaster of major proportions was averted.
October 4, 1979	Heavy equipment cuts through a 50centimetre diameter pipeline spilling crude oil into the river valley. Oil flowed for six hours until containment efforts were successful.
June 8, 1997	Evacuation caused by a backhoe rupturing a natural gas line at 101 Avenue and 101 Street.
October 29, 1998	Trencher hit an eight-centimetre diameter natural gas line at 73 Avenue and 180 Street resulting in a second alarm response.
February 18, 2017	Enbridge pipeline spills 200,000 litres (1250 barrels) of oil condensate in Strathcona County due to a construction accident which struck the pipeline creating the leak.

In the event of an emergency, each pipeline operator maintains a 24hour control centre and emergency shutdowns are initiated when notification is received. In most cases, a member from the company's first response team will arrive within a half-hour to work with the site management team from the police and fire response teams. While police and fire coordinate evacuation and safety measures, pipeline companies focus on repair and restoration of the scene. In addition, the City works closely with the pipeline operator and with EPCOR to ensure the impact to drinking water intakes and plants are mitigated.

Highlights from 2019 also include the following:

- The number of pipeline incidents in Alberta decreased to 390, compared with 415 in 2018.
- About 82 percent of incidents were rated as being "low consequence" in terms of their effect on the public, environment, wildlife, and livestock; 13 per cent were rated as "medium consequence"; and only 5 per cent were high consequence. Learn more about incident consequence ratings in the glossary.
- The number of pipeline incidents that were rated as "high consequence" dropped by 17 per cent, decreasing to 20 incidents in 2019 from 24 incidents in 2018.
- Seventy-five per cent of incidents rated as "high consequence" involved pipelines carrying salt water or oil-well effluent, which is a mixture of oil, gas, and salt water.
- Salt water pipelines had an overall pipeline incident rate of 3.0 incidents per 1000 kilometres per year, while oil-well effluent pipelines had a failure rate of 1.8 incidents per 1000 kilometres per year. This is due to the corrosive nature of these product streams.
- Internal corrosion remained the leading cause of pipeline incidents (35 percent of the total). More than 82 per cent of internal corrosion failures were on steel uncoated pipelines (up from

70 per cent in 2018), with the majority of the remaining corrosion failures being failures on the metallic risers or connections on nonmetallic pipelines.

- Over 62 per cent of pipeline incidents had “little” (less than or equal to 1 cubic metre or about 6 barrels) to no liquids released. In 2019, the largest liquid spill released was 1200 m3 of produced water (water by-product produced from a well bore).

Toxic Gas Release

The Strathcona Industrial Association (SIA) operates 28 monitoring stations to measure general (or ambient) air quality in the region. Together these stations are called the SIA Ambient Air Quality Monitoring network. There are three types of air quality measurements on the Network. Seven stations offer continuous and intermittent monitoring while 21 exposure cylinders offer static monitoring (collection of substances during a one month span).

The SIA Ambient Air Monitoring Network exists to:

- Determine air quality trends;
- Alert industry and government to changes in air quality;
- Review effectiveness of emission control measures;
- Provide data for scientific studies;
- Make air quality information available for our neighbours; and
- Provide real-time (or immediate) data 24-hours a day, seven days a week.

The Network continuously monitors hydrogen sulphide, total hydrocarbons, wind speed and direction, and nitrogen oxides every 30 seconds to produce five minute, one hour, 24 hour, and annual averages. The Network intermittently monitors total suspended particulates for a 24 hour period, once every six days. Static monitoring is done for total sulphation and hydrogen sulphide at one month intervals. Air quality is affected by emissions from industrial operations, motor vehicles, home heating, and natural biological processes. Weather conditions (precipitation, temperature and wind) also affect the measured quality of ambient air.

Fire

An urban fire is an uncontrolled fire in a populated area beyond normal response capabilities. EFRS is well situated across the city with 30 fire stations strategically located throughout the city. EFRS targets response times as per NFPA (National Fire Protection Association) standards:

1. First Unit response time: Seven minutes for the first unit to arrive on the scene, 90% of the time.
2. Full First Alarm Assignment: Eleven minutes for 16 firefighters to arrive on the scene, 90% of the time.

In the event a large residential or industrial fire occurs, EFRS has procedures in place ("second-alarm/third-alarm").

Urban dwelling types in Edmonton[20]:

Dwelling Type	# Units	% by Unit

[20] 2016 Statistics Canada Census data for Edmonton - https://www12.statcan.gc.ca/census-recensement/2016/dp-pd/prof/details/page.cfm?Lang=E&Geo1=CSD&Code1=4811061&Geo2=PR&Code2=48&SearchText=Edmonton&SearchType=Begins&SearchPR=01&B1=All&GeoLevel=PR&GeoCode=4811061&TABID=1&type=0

Single-detached house	180,215	50%
Apartment in a building (5 or more storeys)	25,790	7%
Semi-detached house	22,215	6%
Row house	36,075	10%
Apartment or flat in a duplex	10,010	4%
Apartment in a building (fewer than 5 storeys)	83,775	23%
Other single-attached house	95	0%
Movable dwelling	2650	1%
Total Private Dwellings	**360,825**	**100%**

High Intensity Residential Fire
As Edmonton continues to grow and targets a future population of two million citizens, there is a lot of urban development work to increase density and reduce urban sprawl.

The closure of the City Centre Airport in 2013 also signified a key shift in development of major high rise towers in the downtown core. Most notably, the completed construction of the Stantec Tower and the JW Marriott Edmonton Ice District & Residences in 2018. Edmonton currently has approximately 23 towers above 100 metres tall. The Stantec Tower stands at 66 storeys and 250.8 metres tall as the tallest building in Western Canada. The JW Marriott Edmonton Ice District & Residences stands at 56 storeys and a height of 192 metres. The progression of true skyscrapers in Edmonton has changed the approach and requirements for preparing for major residential fires. The importance of preparation and response techniques for high rise buildings was highlighted by the Grenfell Tower fire in London on June 14, 2017, as the 24 storey building fire spread out of control and resulted in the death of 73 people.

For comparative purposes, West Edmonton Mall has concentrations of 15,000-20,000 people attending during peak seasons. It would be difficult to duplicate a more concentrated mass of people in one residential building. EFRS is prepared for both the challenge of dealing with skyscrapers and massive mall structures.

Edmonton’s "inner city" still contains a number of structures that are questionable in any quality review. This type of neighborhood is subject to urban decay and is undergoing a form of deterioration based on the nature of occupants, low (or non-existent) maintenance, and surrounding culture.

Modern codes and standards and safer building practices have produced better buildings using more non-combustible construction along with the installation of fire sprinkler protection. The Alberta Building Code is thought to be a leader and will set the standard for national and other provincial codes. As such, the risk and impact of major fires is somewhat less of a concern.

Forest Fire (Wildfire)

Edmonton has a picturesque river valley and an extensive park system based around this asset. As well as the river valley park system, there are hundreds of parks throughout the city that are the traditional manicured and well maintained parks, or naturalization parks deemed a low maintenance resource. There are also thousands of acres within the city limits of environmental reserves, agricultural, and wild lands being held for future development.

Large grass fires have been a part of Edmonton's history since it was a fur trading post. Based on 2018, 2019 and 2020 statistics, an average year would have approximately 225 grass and brush fires within the city limits. The expansion of rural land as a result of the Leduc Annexation has also expanded the land EFRS are required to monitor and cover for potential bush fires.

Climatic conditions in Edmonton have a strong bearing on the seasonal grass and brush fire situation with snowfall, warm drying spring winds, and rainfall dictating the extent and duration of the most hazardous periods. During normal years March, April, May, September and October are peak wildland fire months. Climate change impacts have created more inconsistent experiences in precipitation and extreme weather events. Grass fire warnings are now a common occurrence across the entire province during these months to educate citizens and raise awareness when higher likelihood of fires could occur due to environmental conditions.

Average precipitation:.

	1981 to 2010[21]	**2016**[22]	**2017**	**2018**	**2019**	**2020**
Average for Mar, Apr, May	30.2 mm	43.4 mm	47.3 mm	14.9 mm	8.6 mm	36.2 mm
Average for Jun, Jul, Aug	77.7 mm	84.0 mm	44.7 mm	57.1 mm	110.2 mm	103.2 mm
Average for Sep, Oct	32.6 mm	32.0 mm	31.3 mm	37.0 mm	22.9 mm	8.1 mm

The last major wildfire experienced within the province was in May 2016 in Fort McMurray when 88,000 people were forced to evacuate the city (still historically the largest wildfire evacuation in Alberta). Although the fires were far north of Edmonton, the impact of smoke to air quality and evacuated people looking for shelter required a response from Edmonton. The dry weather conditions were also experienced in Edmonton during the same timeframe with fires in west Edmonton forests lining the river valley, in several cases fires spread across a park, playground and nearby houses with cedar shingles.

Grass and brush fires can burn with such intensity that ecosystems can be drastically changed. Without intervention, these burned lands recover slowly and are susceptible to undesirable changes

[21] Government of Canada Climate data - https://climate.weather.gc.ca/climate_normals/results_1981_2010_e.html?searchType=stnName&txtStationName=edmonton&searchMethod=contains&txtCentralLatMin=0&txtCentralLatSec=0&txtCentralLongMin=0&txtCentralLongSec=0&stnID=1867&dispBack=0
[22] Weather Data for Edmonton 2016-2020 - https://edmonton.weatherstats.ca/charts/precipitation-monthly.html

in vegetation composition. For example, when finer species of grass become established in burn areas replacing other vegetation, it disrupts natural systems and, with seasonal changes, creates additional fire risks.

Given the nature and quantity of urban wild land in Edmonton, grass and brush fires are unavoidable. Through concerted efforts of resource management and training of emergency response teams overall impacts can be lessened, but not eliminated. In times of low precipitation, the EFRS will issue fire bans. However, based on historic averages, Edmonton can expect to see at least 225 brush and/or grass fires per year.

Geological/ Hydrological

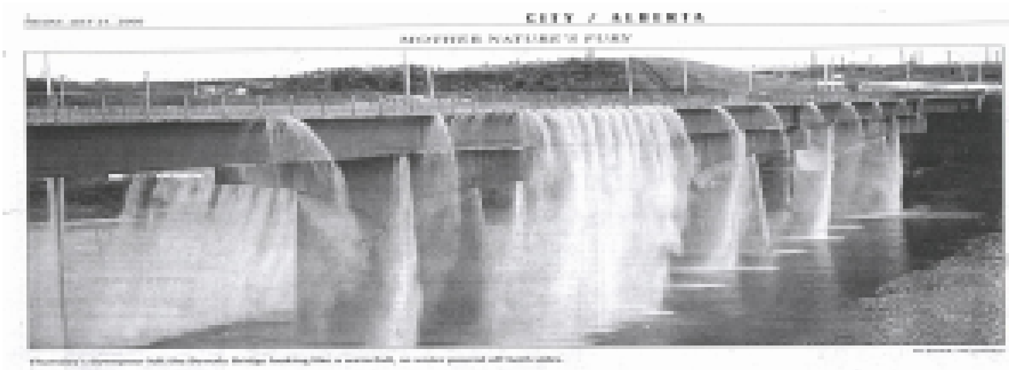
Edmonton is among several major cities in the Prairies with a wonderful river running through the city. The combination of a major river system and the potential for extreme storms leads to risks for flooding and landslides.

Flood (Rainfall/ Run-off)

A flash flood is a localized flood of relatively great volume and short duration as a result of heavy rainfall or dam failure. Edmonton has experienced flash floods due to severe thunderstorms in recent times and it is not uncommon for sections of underpasses along the Whitemud Drive to be flooded during these extreme storms. In addition, climate change increases the frequency and intensity of storm events, which will likely continue to impact community structures, but also increase costs for evacuations, repairs and restoration.

Edmonton has worked incredibly hard to increase flood mitigation planning and recently received among the highest grade ratings for flood mitigation among all Canadian municipalities. Based on the Intact Centre on Climate Adaptation report at the University of Waterloo, Edmonton received a B+ grade. Edmonton excelled at risk management and preparedness for flooding in residential properties. Epcor offers free home flood assessments through three types of flood prevention home checkups to help residents identify and resolve any potential drainage defects to minimize the risk of flood damage. Epcor also provides updated flood maps for residences to help educate citizens and provide proactive self assessments. Further proactive work continues with additions of dry ponds in flood prone neighbourhoods and installing new smart sensors as part of the early warning systems in stormwater.

Examples like on July 20, 2000 could still occur, the northeast corner of Edmonton experienced a very sudden, intense rainfall that resulted in localized surface flooding, turning the Beverly Bridge into a waterfall.



(Photo Courtesy of the Edmonton Journal)

Storm cells that affect Edmonton tend to be limited in size, one-kilometre diameter being normal. However, depending upon the intensity, duration, and frequency of seasonal rainfall, several areas have been impacted by sudden heavy downpours. Results include flooded basements and underpasses, plugged catch basins, popped manhole covers, and impassable streets. During exceptionally wet years, land slippage has occurred, especially along riverbank and freeway embankments as well as under roadways in urban areas.

Date	Major Events
1974, 1975	Mayfield area (156 Street to Mayfield Road, 107 to 111 Avenue).
Jun, Jul and Sep 1978	Most residential areas of the south side.
July 22, 31, and Sep 2, 1987	Citywide.
July 5, 1988	Basements flooded citywide.
July 3, 1990	North side, business core, and university areas.
June 7-8, 1991	63 to 87 Avenue, 107 to 117 Street, Millbourne Road to 23Avenue, 66 to 91 Street.
July 4, 1995	50 to 76 Street and 82 to 98 Avenue.
1999	Citywide.
July 20, 2000	Northeast corner of the city.
July 11, 2004	Over 4,000 homes flooded
July 11, 2012	A severe thunderstorm caused flooded streets, yards, basements and construction sites in Edmonton. Sections of Whitemud Drive were underwater at 111th Street west of Calgary Trai, Mill Woods intersection at 66th Street and 34th Avenue was also flooded.
July 27, 2016	Whitemud Freeway flooding

Although Edmonton has a history of significant intense rainfall, the overall effects are rarely of a lasting nature. When backups occur, the storm water disposal system is designed so that areas are drained quickly and flooding of a dramatic nature rarely lasts more than a few hours. A year does not pass where residents do not experience flooded basements, streets, and plugged catch basins in some part of the city.

A Millbourne home during the flood of 2012. PHOTO BY BRUCE EDWARDS

Flood (watercourse)

A waterway flood is "a rising or overflowing tributary or body of water that covers land that is normally dry. The 100-year flood usually defines flood-prone areas. A 100-year flood has a 1% chance of occurring in any given year. It is possible to have a 100 year flood each year."

1915 Flood Rossdale river flats. Photo courtesy of City of Edmonton Archives

Mountain streams via Abraham Lake and the Brazeau and Nordegg Rivers feed the North Saskatchewan River. The North Saskatchewan River builds to become a significant Canadian river eventually feeding into the Hudson Bay. The North Saskatchewan River has fluctuations of flow, height, color, and clarity throughout the year, along with constantly shifting sandbars.

Unlike other rivers across the prairies that tend to flood in the spring, the North Saskatchewan River has its greatest flow in early summer when the snowpack melts in the mountains. If torrential rains in the southwest follow sudden hot weather on the eastern slopes, the river can overflow its banks.

In modern times, the greatest known flood of the North Saskatchewan River took place in late June of 1915 when Riverdale was flooded all the way to the alley east of 93 Street. With the Big Horn and Brazeau dams controlling flow upstream, flooding can now be avoided for the most part.
The base water level of the North Saskatchewan River is 609.4 metres above sea level with 612.05 metres being the average summer flow level. Flood conditions develop when the water level exceeds the base level by nine meters.

Previous floods:

Date	Major Events
1915	Water levels reached 12.1 metres above base level.
1944,1952,1954, 1972	Water levels reached 9.04 metres above base level.
1986	Water levels reached 10.57 metres above base level.
2020	Water levels reached 8.6 metres above base level

Concern begins when water levels increase beyond 4.5 metres above base. At 4.6 metres, floodwater becomes a problem at Fort Edmonton Park. At 5.2 metres, Rundle and Gold Bar Parks, and Keillor Road are affected. At 5.5 metres, all trails through the river valley park system are closed. At 5.8 metres, the trail system is covered and boat launches are closed. At 10.5m above base the river threatens water treatment plants, drainage capacity in the low-lying areas of Rossdale, Riverdale, and Cloverdale, and some of the power cables that cross the river.

Advance flood warning is provided through Alberta Environment and Parks, Environmental Monitoring and Science Division, who monitor conditions year round. Through monitoring of seasonal snowfall and rainfall, information is issued to the public regarding current issues affecting stream flows in the province. Issues that may pertain to current advisories are high stream flow, spring runoff, river freeze-up or break-up, as well as information that could affect river conditions in the province and Edmonton.

Forecaster's comments, Near Real Time Hydrometeorological Advisories and Warnings, and Water Supply and Weekly River reports are available on the Alberta Environment and Parks: Alberta River Basins website at: https://rivers.alberta.ca/# . In addition, EFRS closely monitors river conditions.

Due to increased monitoring of eastern slope snow packs, spring thaws, and late spring rainfall (as well as water level maintenance through upstream dams), the City is able to put in place flood mitigation procedures including permanent and emergency protective works around water treatment plants and electrical substations.

Landslide (Erosion along riverbanks)

A landslide is the rapid downward movement of a mass of rock, earth, or artificial fill on a slope. Edmonton is not subject to landslides by definition, but rather land slippages that occur at a slower rate and tend to give warning signals (small surface cracks on roadways, sidewalks, and embankments) before they happen. Edmonton has a long history of land slippages (erosion) along the river valley, freeways, ravines and creeks. Slippage can usually be attributed to heavy rainfall.

The most spectacular incident of a land slippage (erosion) in Edmonton in recent history occurred October 23, 1999. It resulted in the evacuation of 23 families after a residence on Whitemud Road slipped off the eroded riverbank. Three homes were destroyed (one through direct collapse and two were demolished after being deemed unsafe). The combined value of the homes was over $1,650,000 along with an estimated cost of $90,000 to clean the site of debris. This area was on a layer of sand situated well below the surface. Ground water combined with sources acting as a lubricant, and the riverbank shifting through normal erosion, the area began to slip away from the more stable landmass beside it. Slow steady rain for a number of days caused water to percolate through the layers of topsoil resulting in a situation of “supersaturation” that acted as a lubricant causing the instability. Since this incident, some residences have installed vertical and horizontal wells to assist in draining water on their properties, although the city continues to monitor the embankments for erosion.

(Photo courtesy of Ed Kaiser, The Edmonton Journal)

Slides generally happen in high plastic types of materials. The slide mass could be composed of materials that are sitting on a layer of bentonite or another plastic type material. The slide zone becomes wet and lubricated, accelerating the slide. The depth of these surfaces is usually related to the size of the slide.

Along the river valley erosion is a constant factor taken into consideration with the constant undercutting of the banks by strong currents. Flooding, although a cause of damage, is less of a factor than the sudden subsidence of water level. On average, seven or eight incidents of off roadway land slippage and one incident every two to three years that affect roadways occur in Edmonton.

Through geotechnical engineering, potential problem areas are monitored regularly. Erosion protection is initiated along suspect or susceptible areas by measures that range from building retaining walls to maintain roadways, to simply rerouting trails and repositioning bridges through the park systems to more stable ground.

Significant slides have occurred at:

- Whitemud Drive from 156 to 159 Streets;
- 105 Street and 98 to 99 Avenue (retaining wall installed);
- Victoria Park Road;
- Saskatchewan Drive west of 99 Street;
- East and south on Emily Murphy Park Road;
- Grierson Road;
- Ada Boulevard at 38 Street;
- Fortway Drive at 109 Street.
- McDougall Hill;
- Groat Road at 102 Avenue; and
- Whitemud Drive at 142 Street (upgraded retaining wall)

<u>Public Disorder</u>

The City of Edmonton is considered to be a peaceful community. Numerous mass gatherings are held each year in celebration of sporting or cultural events and special holidays. As well, Edmonton has served as host to a variety of political and social demonstrations on the steps and grounds of the Provincial Legislature. A number of factions throughout the years have also held strike posts due to real or imagined labour disputes. Each of these events is usually carried out without incident. However sporadic outbreaks of unruly demonstrations and public unrest have occurred.

As recently as the summer of 2020, Black Lives Matter anti-racism protests resulted in several minor events that required police intervention as citizens marched in the hundreds down Jasper Avenue in response to the death of George Floyd. Police presence was required throughout the different marches and demonstrations to ensure levels of public disorder did not escalate to uncontrollable situations. During 2020 and 2021, Edmonton also had several peaceful anti-mask and anti-restriction rallies, mainly centred around the Alberta Legislature grounds.

Civil Disturbance

Typically this type of public disorder occurs at natural gathering places: Jasper Avenue, Whyte Avenue, the University area. Most violence, albeit infrequent, that has occurred has been aimed against property rather than people. Although no single condition or indicator precedes these unruly outbreaks, the consumption of alcohol has been a prime factor.

In May of 1984, when the Edmonton Oilers (NHL hockey team) won their first Stanley Cup, the length of Jasper Avenue quickly filled with vehicles and celebrants on foot. Efforts to manage and disperse the crowds were met with resistance. Numerous cars and plate glass windows fronting Jasper Avenue were damaged and litter was strewn everywhere. In the subsequent four-year streak that The Edmonton Oilers won the Stanley Cup, the Edmonton Police Service was prepared and street celebrations following these wins passed with little incident; although in June 1987 vandalism and damage were caused to businesses along Jasper Avenue. Then again in May 2006 during the Stanley Cup playoff run, regular crowds causing violence occurred along Whyte Avenue with fans setting fire to telephone booths, wood pallets and street signs. Policing costs in 2006 exceeded $2 million dollars during the playoff run.

On July 1, 2001 (Canada Day), a rock concert was held on the Legislative Grounds. When the festivities were over, many of those in attendance made their way south over the High Level Bridge and joined an already swelling crowd of people along Whyte Avenue. When the Whyte Avenue bars closed shortly after, the already crowded sidewalks prompted many to spill out onto the street. Attempts by police to disperse the crowds were ignored and a huge melee ensued. When the evening was over, there were 37 arrests and a total of 93 charges laid. Seven people required transport to hospital with an unknown number of injured making their own way to medical facilities. Direct property damage was estimated to be $165,000; in total, the City of Edmonton spent over $1,000,000 in clean up and overtime costs.

Labour Disruption

Labour Disruption has also been part of history since the industrial revolution and mass production processes introduced in the 1920s gave rise to greater efficiencies in manufacturing and other industrial sectors. At the same time, many work forces formed coalitions or unions to represent the collective needs of workers or the workers of a specific industry segment. Over the years, many strikes have been organized in protest when perceived or real needs are not being met and contract negotiations break down. In the majority of cases, picket lines are set up and carried out without incident. However, in the spring of 1986, dissension broke out in a gathering of Gainers meat packing plant strikers. The Edmonton Police Service riot squad (now called the Public Safety Unit) had to be called in and the strike was continually monitored throughout its duration. Since that time, many strikes have occurred and despite some minor vandalism, similar activity that occurred during the Gainer's strike has not occurred.

The Edmonton Police Service will not normally station uniformed officers at strike scenes, but will only intervene subject to a court order or emergent circumstances dealing with public safety. The Edmonton Police Service will monitor the event and if required, develop a Standard Operations Plan to deal with the specific event.

Within the City of Edmonton, active and up to date continuity plans are developed and updated periodically to plan for potential labour disruptions to ensure critical services are maintained within the city.

Structural

Bridge/ Structural Collapse

Structural collapse is an uncommon occurrence in Edmonton. It is most likely to occur during construction, demolition, renovations or after rain events that cause ground subsidence under roadways. During these times all of the normal structural components may not be in place, which makes the structure vulnerable to wind pressures or snow and rain loads. Occasionally there have been problems where the bracing for wet concrete has not been sufficient to hold the product in place until it develops its own strength and thus collapses.

Structural collapse is also possible due to design flaws or poor construction practices but neither of these seem to be a significant problem in Alberta. Collapses have occurred due to snow or water buildup on roofs but they are very infrequent, as the building codes are strict in this area.

Structural collapse is also possible due to aging, poor maintenance, or weathering of structures. The most common concern in this area is likely rusting of steel beams and connections. Pieces of buildings fall off when steel connectors have deteriorated due to rust. Around 2000, a large concrete railing fell off a building in the West-end. Rusting is a major problem with concrete structures that rely on steel reinforcing bars, and pre- or post-tensioned cables to supply structural strength. Years of freeze/thaw cycles create cracks in the concrete that allow water to contact the steel beams or connectors. There have been many rehabilitation projects completed on bridges and parking structures for this reason.

Terrorism

“In Canada, section 83.01 of the Criminal Code[1] defines terrorism as an act committed "in whole or in part for a political, religious or ideological purpose, objective or cause" with the intention of intimidating the public "...with regard to its security, including its economic security, or compelling a person, a government or a domestic or an international organization to do or to refrain from doing any act." Activities recognized as criminal within this context include death and bodily harm with the use of violence; endangering a person’s life; risks posed to the health and safety of the public; significant property damage; and interference or disruption of essential services, facilities or systems.“[23]

Although terrorism has not been new in the world, the events of September 11, 2001 has certainly been a catalyst for the emergence of more domestic and international terrorist threats across many democratic nations. The deliberate air plane crashes in the United States in New York City, Washington D.C., and Pennsylvania, "terrorism" is being closely monitored by government officials at all levels. (See also Dangerous Goods - Biological Hazards.)

Hostile Acts

On September 30, 2017, Edmonton experienced its first domestic terrorist incident when an individual influenced by an ideological belief for extremism in support of the Islamic State sought to injure and kill innocent people after an Edmonton football game. The attacker deliberately rammed through barricades and struck a police officer with his vehicle sending the officer flying. The attacker got out of his vehicle and viciously attacked the officer stabbing him numerous times. The attacker fled on foot and a short time later was observed in a rental truck. The attacker fled from police in this rental vehicle deliberately striking 4 pedestrians before being captured by police.

Additionally on November 6, 2018, an explosive attack took place in the underground parkade of the Strathcona County Community Centre Library. The lone attacker caused an explosion using a home made device with tannerite which sparked a second explosion with a gas tank. The motive of the attack was unknown as the attacker committed suicide during the attack. But the unsettling nature of the events is a reminder that threats are present and possible.

Utility Disruption

[23] Definition of Terrorism from the Department of Justice Canada - https://www.justice.gc.ca/eng/rp-pr/cj-jp/victim/rr09_6/p3.html

Computer/ Hardware/ Software Failure

In the modern era of technology, hardware and software failures are major risks in creating a disruption of services. Almost all organizations (public and private) operate backup systems for major technology infrastructure. The City of Edmonton has current backup plans from the Open City and Technology Branch which are frequently updated to ensure contingency plans are in place for hardware and software failures. In addition, private sector critical infrastructure operators in the electricity, water and telecommunications industries are either regulated or externally certified to have cyber-security measures and cyber-attack emergency response plans.

Communication Equipment Failure

A communication failure is the widespread breakdown or disruption of normal communication capabilities. This includes cell phone disruption, telephone outages, loss of local government radio facilities, or long term interruption of electronic broadcast services.

Edmonton is served by many sophisticated methods of communication that have contingency plans, back-up systems, and recovery procedures in place. In the event of a power failure, cell phone towers and telephone systems in Edmonton are powered by back-up battery systems and are capable of being operational for up to eight hours before needing recharging.

In the event of long term power disruption, Telus has specialized vehicles with power generation capabilities to recharge batteries in each exchange to restore service. Telus has extensive recovery plans, specialized equipment, an emergency operation centre, and rapid response teams in place. Recovery time for restoration of telephone systems would depend on the magnitude of the incident. During events like the tornado in 1987, telephone systems were temporarily unable to handle phone calls due to volume. TELUS also coordinates its response with electrical utilities to ensure telecommunications systems are included in power restoration priorities.

In the newer areas of the city, telephone lines are buried underground, thus reducing the potential threat. Along with increased technology, cell phone coverage has increased dramatically. The next phase of 5G network infrastructure will further expand coverage into areas previously unavailable, like the river valley trail systems.

In the event of disaster, private broadcasters are very important outlets for public information. Most people will rely on radios tuning in one of dozens of radio stations in the city. The local television stations become an important factor for news distribution once power has been restored. The cable and satellite television providers (Shaw, Telus and Bell) are also a key to assure that local news and updates are carried to those relying on cable connections and satellite rather than old television aerials.

Most broadcasters have back-up power generation capability at their transmission sites and studios. In the event of a lightning strike at a transmission site, backup transmitters can be utilized to restore at least a portion of the service.

Communication systems within the 911, Police, Fire, and Ambulance systems are backed up by emergency power generators. If a dispatch centre becomes inoperable, there are contingency plans and systems in place for transfer to alternate backup sites. The new Telus Next Generation 911 (NG911) will also be adding new capabilities to 911 response with more data provided from cell phone 911 calls and a network for emergency dispatch communications. More information on the purpose and capabilities are located on the Government of Canada CRTC website. The city has also upgraded to the provincial AFRACS radio network for emergency responders for secure communications.

Telecommunication companies and civic emergency broadcast systems have backup power sources and transmitters that would enable distribution of information. The City of Edmonton has backup power for all emergency dispatch systems and alternate sites available in the event of a power failure and the need for evacuation of dispatch centres. It is unlikely there would be long term communication failures that would affect more than 10% of the population for an extended period of time.

Natural Gas Disruption

The majority of homes in the Edmonton area are heated by natural gas. A small number of homes (mostly mobile homes) utilize propane for heating. Emerging renewable technologies are starting to be introduced in residential homes through solar panel generators but this has not gained enough momentum yet to support an alternative to natural gas heating. There have been a number of natural gas supply interruptions in Edmonton over the years and are primarily caused by third party hits or damage to distribution lines.

A sampling of the types of incidents is listed below:

Date	Major Events
July 13, 1977	Gas line at 143 Street and 51 Avenue cut by bulldozer. Fifteen homes evacuated as a precaution.
June 14, 1985	West Edmonton Mall evacuated after a front-end loader ruptured a 4-inch gas line.
February 19, 1980	Intermediate 8-inch gas line on 97 Street and 39 Avenue ruptured by subcontractors.
July 26, 1985	At 10:45 a.m. heavy equipment hit a 6-inch natural gas line near 178 Street and 90 Avenue evacuating six square blocks. At 12:45 p.m. a soil cement mixer hit the same gas line four metres from the first hit.
Spring 1997	Area evacuated after a backhoe hit a 4-inch gas line at 100 Street and 102 Avenue.

There has not been any widespread disruption to the natural gas or home heating supply. Depending upon the severity of the circumstances, natural gas could conceivably be restored in 24 to 96 hours. The full repair to the original state could take several weeks or months.

Power Disruption

Power failure/shortage is defined as long term or widespread loss or reduction of electric power, or a shortage of petroleum products, which could have an adverse effect on the preservation of life and property. Power outages can impact critical facilities where those facilities do not have backup power. For that reason, electrical utilities work closely with the City to mitigate protracted impacts, and where at all possible, utilities avoid impacting hospitals/fire stations/police stations/correctional facilities when implementing rotating power outages.

Previous incidents include:

Date	Major Events

March 12, 1979	A 12 hour major power outage in the city's core sent thousands of downtown workers home.
July 4, 1980	Lightning knocked out 10 transformers resulting in some areas being without power for 2 hours.
July 23, 1980	Storm left parts of the city without power.
December 3, 1985	Millwoods Recreation Centre evacuated during a power outage that affected a 234 square block area.
July 18-19, 2009	Windstorms caused 57,000 homes to be without power
July 2012, January 2020	Alberta Electric System Operator (AESO) Emergency Energy Alert, not enough power in the grid, potential rotating power outages

EPCOR Distribution, the main supplier of power in Edmonton, has 205 circuits covering approximately 30 square blocks with 1,500 metered customers per circuit. There is a yearly average of 360 outages affecting a 20 square block or larger, calculated on 60% of the total outages area.

The average restoration time per circuit is 90 minutes with a worst case scenario being a total blackout of the entire province. The Power Pool of Alberta runs a "black start" exercise every year in which all companies participate. A realistic restoration time would be 12-14 hours for total restoration.

Water Main Break
A water main break could cause significant damage to both infrastructure and cause shortage of water for residences. August 1-3, 2018 a major water main break occurred that impacted several downtown high-rises, businesses, and the Downtown LRT for several days. The EOC was activated to assist in supporting this event. Many minor water main breaks are quickly triaged and contained for damage with services being restored relatively quickly while major repairs are completed.

Water Pollution/ Contamination
Edmonton's water treatment plants produce between 350-375 million litres of water per day supplying Edmonton and 80 surrounding communities with a total population of 1.3 million people. EPCOR Water Services tests the City's water supply at various locations using sophisticated lab equipment to ensure that its drinking water lives up to its credo "better than it has to be." The tests are done with 149 physical, chemical, and microbiological parameters. Edmonton consistently tests well within safety limits.

The treatment plants rely on clarification, filtration, chloramine, UV disinfection to remove over 99.7% of the "bugs." With modern safeguards, monitoring, and higher levels of regulation, there is a decreasing risk of Edmonton's water supply becoming contaminated.

Water Shortage
The North Saskatchewan River supplies the City of Edmonton and surrounding area with a steady supply of water. Water levels throughout the year follow a natural ebb and flow; as the snowpack melts high in the mountains and with spring and early summer rains, the river reaches its usual high peak.

Providing that reservoirs are full or close to full, and that demand is not higher than normal, Edmonton can last about two to three days without the treatment plants being operational, when water conservation and demand management measures are in place.

Low water levels in the river affect the suction lift of the low lift pumps that pump river water into clarifiers. Once the water is in the clarifier, the rest of the process flows by gravity. With suction reduced, the pump's output capacity decreases slightly.

Rossdale's maximum capacity is about 280 million litres per day. There are pumps installed with a low lift capacity that can pump at a rate of 20-200 million litres per day so low water levels do not have a major effect on the water treatment plants.

In the event that water service is disrupted to residential and commercial areas for an extended period, the city has methods and systems in place to supply water to its customers. The most predominant provision for water service would be through a system of hoses connected to individual services in the affected area.

Appendix 1 - Detailed Scoring Summary

Risk Assessment Report - March 2021 - LINK
Risk Assessment Scoring Sheet - March 2021 - LINK

Summary of Risk Assessment Scoring Sheet

Hazard Type	Frequency	Consequence	Changing Risk	Risk Level (F*C*ΔRisk)
Blizzard	Almost Certain (6)	Severe (4)	4	Extreme (96)
Extreme Cold	Almost Certain (6)	Severe (4)	4	Extreme (96)
Human Health Emergency	Probable (4)	Catastrophic (6)	4	Extreme (96)
Chemical, Biological, Radiological, Nuclear Event	Unlikely (3)	Catastrophic (6)	4	Extreme (72)
Pipelines	Unlikely (3)	Catastrophic (6)	4	Extreme (72)
Terrorism	Probable (4)	Catastrophic (6)	3	Extreme (72)
Civil Disturbance	Likely (5)	Severe (4)	3	Extreme (60)
Agricultural Plant Disease/ Pest Infestation	Unlikely (3)	Catastrophic (6)	3	Extreme (54)
Hazmat (Fixed Site)- Pipeline/ Storage Facility	Unlikely (3)	Catastrophic (6)	3	Extreme (54)
Hazmat (Transportation) - Rail	Unlikely (3)	Catastrophic (6)	3	Extreme (54)
Hazmat (Transportation) - Road	Unlikely (3)	Catastrophic (6)	3	Extreme (54)
High Intensity Residential Fire	Unlikely (3)	Catastrophic (6)	3	Extreme (54)
Oil and Gas Emergency	Unlikely (3)	Catastrophic (6)	3	Extreme (54)
Floods (Rainfall/ Run-off)	Probable (4)	Severe (4)	3	Very High (48)
Labour Disruptions	Probable (4)	Moderate (3)	4	Very High (48)
Major Road Accident (vehicular)	Probable (4)	Severe (4)	3	Very High (48)
Snow	Almost Certain (6)	Slight (2)	4	Very High (48)

Toxic Gas Release	Very Unlikely (2)	Catastrophic (6)	4	Very High (48)
Water Pollution/ Contamination	Very Unlikely (2)	Catastrophic (6)	4	Very High (48)
Floods (Water Course)	Unlikely (3)	Very Severe (5)	3	Very High (45)
Extreme Heat	Unlikely (3)	Moderate (3)	4	High (36)
Rail Accident	Unlikely (3)	Severe (4)	3	High (36)
Computer/ Hardware/ Software Failure	Probable (4)	Slight (2)	3	Moderate (24)
Forest Fire (Wildfire)	Very Unlikely (2)	Severe (4)	3	Moderate (24)
Water Main Break	Probable (4)	Moderate (3)	2	Moderate (24)
Landslide	Very Unlikely (2)	Very Severe (5)	2	Low (20)
Airplane Crash	Rare (1)	Catastrophic (6)	3	Low (18)
Hail	Unlikely (3)	Moderate (3)	2	Low (18)
Power Disruption	Very Unlikely (2)	Slight (2)	3	Low (12)
Tornado	Rare (1)	Catastrophic (6)	2	Low (12)
Water Shortage	Very Unlikely (2)	Slight (2)	3	Low (12)
Bridge/ Structural Collapse	Rare (1)	Moderate (3)	3	Very Low (9)
Communication Equipment Failure	Unlikely (3)	Minor (1)	3	Very Low (9)
Natural Gas Disruption	Very Unlikely (2)	Minor (1)	3	Very Low (6)