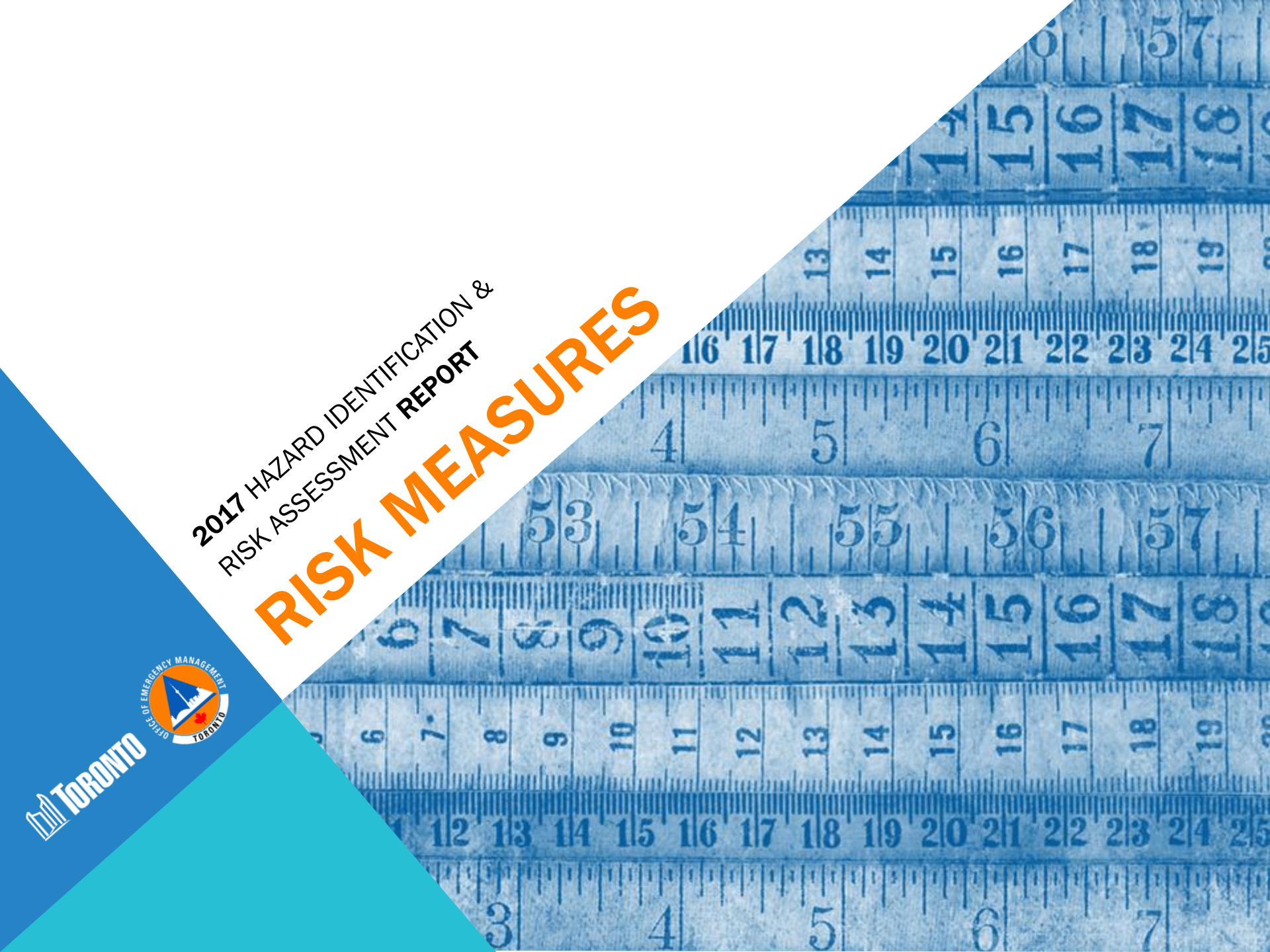
2017 HAZARD IDENTIFICATION & RISK ASSESSMENT **REPORT**

RISK MEASURES



HAZARD IDENTIFICATION & RISK ASSESSMENT:
An evaluation method used to understand hazards which could pose a risk to an area. It is used to identify hazards and assess associated risks, to determine which hazards are most likely to result in an emergency.

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Report Contents

THE OFFICE OF EMERGENCY MANAGEMENT

OUR WORK

Helping Toronto and its residents prepare for and deal with major emergencies is the primary purpose of the Office of Emergency Management (OEM), the City of Toronto's coordinating agency for emergency activities.

RISK ASSESSMENT

The City of Toronto is vulnerable to numerous hazards. The hazards can be natural such as extreme weather, human-caused such as a cyber-attack, or technological such as utility failures and power failures. It's our role to assess the risks, and determine which hazards are most likely to result in an emergency.

OUR LEGISLATED ROLE

The assessment of hazards and risks for the City of Toronto is a requirement of the Emergency Management and Civil Protection Act, carried out by the Office of Emergency Management.

Image 1: The City of Toronto, Emergency Operations Centre

WHAT IS HIRA?

EVALUATION METHOD

Hazard Identification and Risk Assessment is an **evaluation method** used to understand hazards.

For each hazard identified, this method creates:

- a risk profile
- a risk score

These two items provide a guideline to determine which are most likely to result in an emergency.

The method includes interviews with subject matter experts, research, data analysis, and review by the City of Toronto Emergency Management Working Group.

EFFECTS OF HAZARDS

DIRECT

Effects created by the hazard itself.

e.g. Rainfall → ***Flooding***

SECONDARY

A subsequent effect of initial impact.

e.g. Rainfall → Flooding → ***Roads Closed***

CASCADING

Effects which are more than once removed from the initial impact.

e.g. Rainfall → Flooding → Roads Closed

→ ***Traffic Congestion***
→ ***Disruption of services***
→ ***Reduced tourism***

UNDERSTANDING HAZARDS

Key Questions:

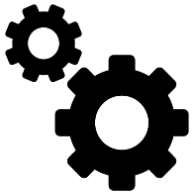
What hazards could threaten the City?

How frequently do they occur?

What could be their impact?

Natural

Cased by forces of nature. Human activity may trigger or worsen the hazard.



Technological

Arises from the manufacture, transportation (including supply systems), and use of materials, technology and/or infrastructure.

Human-caused

Results from direct human action or inaction, either intentional or unintentional.

THE HUMAN FACTOR

While we often think about weather-related events being hazardous, people and technology can also trigger or compound the effects of emergencies.

Intentional attack: Intentional damage, destruction or harm, regardless of motive.

Malfunction: failure of equipment or machinery to function normally or satisfactorily, resulting in damage, destruction or harm

Planned Outage: a period when a service is not available or when equipment is closed down, resulting in damage, destruction or harm.

Accident: a situation where human action or error results in damage, destruction or harm, even though reasonable care is taken, and conduct follows or exceeds accepted standards.

To understand the effects of hazards on residents, city staff, services, programs, and operations, it is crucial to consider who or what may be the vulnerable to the factors listed above.

VULNERABILITY & RESILIENCE

The capacity of the city to anticipate, cope with, resist, adapt to, and recover from the impact of shocks and stresses, defines how resilient or vulnerable it is.

The following are considered in HIRA analysis:

Environmental: The design/use of the built environment, and where it intersects with the natural systems under and around it.

Social: characteristics inherent in social interactions, institutions, and systems of cultural values.

Physical: aspects such as population density levels, design and materials used for critical infrastructure, or location of housing

Financial: factors which are dependent upon the economic status of individuals, organizations, communities.

CRITICAL INFRASTRUCTURE

SYSTEMS APPROACH

Critical infrastructure is interdependent, interactive, interconnected networks of institutions, services, systems and processes.

They meet vital human needs, sustain the economy, protect public safety and security, and maintain continuity of and confidence in government.

MANAGING RISK

Hazards that impact critical infrastructure are far more likely to produce secondary or cascading effects, and increase the risk to public safety.

Risk management techniques help reduce vulnerabilities by decreasing the frequency, duration and scope of disruptions and facilitating response and recovery.

SCORING RISK

The Office of Emergency Management considers a variety of factors, evaluates risk, and produces a risk score. Scores fall into the following categories:

<=20	21-40	41-60	61-80	81-100	>100
VERY LOW	LOW	MODERATE	HIGH	VERY HIGH	EXTREME

The ‘risk score’ can be used to rank and compare the risk of hazards. It is calculated as follows:

Risk = Frequency X Consequence X Changing risk

2017 TOP RISKS

	Frequency	Consequence	Changing Risk	RISK SCORE TOTAL	Risk Category
Electrical Power Disruption	5	5	4	**81**	Very High
Explosion/Fire	6	5	3	**74**	High
Winter Weather	5	4	4	**70**	High
Pandemic	4	6	4	**67**	High
Cyber Attack	4	5	4	**63**	High
Terrorism/CBRNE	4	5	3	**60**	Moderate
Epidemic	3	6	4	**58**	Moderate
Flood	5	4	3	**57**	Moderate
Oil/Natural Gas Emergency	3	4	4	**48**	Moderate
Extreme Heat	5	3	4	**44**	Moderate

Severe Weather

Severe weather, including extreme heat and winter weather, can have serious impacts to homes, businesses, and infrastructure. This hazard has historically been the cause of Toronto's worst emergencies, from Hurricane Hazel in 1954 to the record-breaking rainfall of July 2013.

The risk from this hazard is increasing. As temperatures become more extreme, the severity of weather increases, and such events become more common every year. Aging infrastructure also increases the risk.

Flooding

Toronto's risk of flooding is closely tied to the risk of severe weather.

Watersheds in Toronto are at high risk for 'pluvial' flooding; when rainfall or snowmelt overwhelms the capacity of urban drainage systems. Toronto also commonly experiences flooding from over-full rivers and streams, and is at risk of flash flooding. This rapid on-set flooding is what made the heavy rainfall of 2013 so damaging, as water rises quickly, in a short amount of time, and with little or no advanced warning.

Natural

Cased by forces of nature. Human activity may trigger or worsen the hazard.

Human Health (Pandemic / Epidemic)

Health effects caused by extreme weather (such as heat stroke), illness including Pandemics and Epidemics, intentional chemical or biological attack are all significant for Toronto. These events types are assessed independently in the HIRA.

The evolution of micro-organisms (including antibiotic resistance), alteration of habitats, increased frequency and decreasing duration of travel, and warming of global temperatures are all likely to increase the risk of major incidents of human illness.

Like all hazards, past events help us understand the potential effects. For example, past influenza and SARS outbreaks demonstrate the potential severity of pandemic illness, and help experts understand outbreak and spread patterns. Appropriate planning and surveillance can radically reduce the risk of these illnesses.

In an extreme case, illness could spread quickly in Toronto and also effect the operation of healthcare services, create staff shortages, negatively effect the tourism industry, or adversely impact local, regional, provincial and national economies. As Toronto is a large and highly connected urban centre, the rapid spread of disease could represent a serious risk.

Natural

Cased by forces of nature. Human activity may trigger or worsen the hazard.

Fire/Explosion

In addition to routine emergency calls, fires can often cause extensive damage to property, evacuations of large numbers of people, restrictions on the re-entry of homes and businesses, and more.

In these cases, fires pose a significant but mostly localized, public safety risk. Highrise buildings, especially in dense urban areas, represent a particular challenge for evacuation and rescue operations, as well as continuity of local critical infrastructure.

Technological

Arises from the manufacture, transportation (including supply systems), and use of materials, technology and/or infrastructure.

Electrical Power Disruption

Redundancy within Toronto's huge, networked power system, and its substantial capacity to tolerate fluctuating demand, results in a resilient power infrastructure.

However, damage to the energy supply chain can adversely affect large areas of the City, or even energy supplies in other municipalities or regions. Cyber threats and severe weather currently represent the highest threat to this system, which could also have widespread secondary effects in major industries including the health and telecom critical infrastructure.

Cyber Threats

Our society relies on digital systems for governance, business and almost every aspect of daily life. As our world becomes more connected, the risk associated with cyber-attacks increases.

A downside of digital networks is that security is not consistently controlled or monitored across the many interconnected systems. While large-scale consequences are not common, they are possible - from malicious attacks to accidental data loss.

Human-caused

Results from direct human action or inaction, either intentional or unintentional.

Terrorism

Terrorism can pose significant challenges for law enforcement and public safety agencies, particularly in the case of 'lone-wolf' perpetrators.

Recent events show that 'soft' targets, which include malls, plazas and public events, are increasingly targeted in terrorist attacks. These are difficult to predict and protect against because the purpose of such places is for them to be open and accessible. There are also thousands of public events every year.

There are significant resources dedicated to preventing such attacks in Toronto and across Canada, that routinely mitigate against this threat to public safety.

CRITICAL FINDINGS

Network Approach to Risk

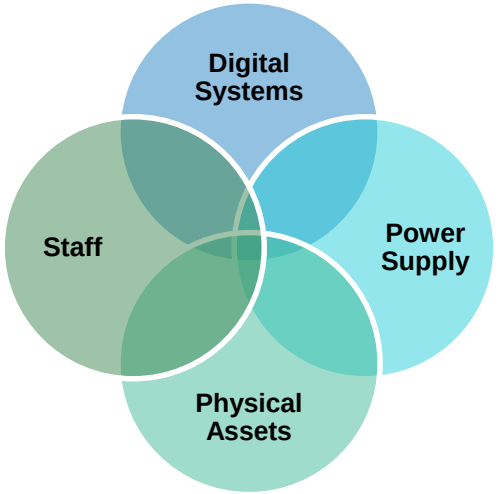
It is important for all critical infrastructure partners to move beyond static models of system assessment, and work together to improve understandings of interdependency. This approach serves the greatest benefit to mitigating risk to connected critical infrastructure, including power supply.

Future risk assessment should focus on these areas in particular, and utilize a collaborative approach, alongside tools that are capable of identifying potential systematic vulnerabilities.

Cyber Risk

The greatest emerging risk for Toronto is cyber-related threats. Digital systems are one of four vital components for critical infrastructure operations, along with staff, power supply and physical assets. Outages of digital systems and/or exploitation of the access they provide to core functions of operations, can lead to outages, malfunctions, data loss and potentially serious damage to vital systems.

The ever-changing potential vectors for such attacks, their sophistication, and the increasingly interconnected nature of almost every aspect of society, increase the potential for such threats to cause system-level or even network-wide damage. Federal legislation and guidance in this area is expected to be strengthened with changes to data security and privacy legislation expected by the end of 2017, which will alter the risk profile.



CRITICAL FINDINGS, CONTINUED

Clarity in Communication
It is evident from the analysis that efforts to improve communication between and across divisions, partners and stakeholders across the City of Toronto have helped facilitate increased participation and contributions to more holistic risk assessment. HIRA research and interviews highlighted that clarity of communication has a significant impact on the effectiveness of response. Recent efforts to build relationships across divisions, through forums such as training and exercises have helped contribute to the improvement of communications.

Groups such as the Special Events Oversight Group are also extremely effective in this regard. This group provides an opportunity for divisions to discuss and assess the risk related to events occurring in the City, as well as for public safety agencies to actively participate in planning discussions.

Informing Mitigation Efforts
The much improved quality and depth of the 2017 HIRA will help better inform ongoing risk-based mitigation and preparedness programs. This includes a whole-of-society approach to addressing highlighted risks in the analysis of hazards at smaller geographical areas within the City of Toronto.

The completion of phase 1 of the strategic plan for HIRA, to build a more robust HIRA methodology and analysis, will now form the basis for future assessments. Analysis will continue in phase 2, outlined on the following page.

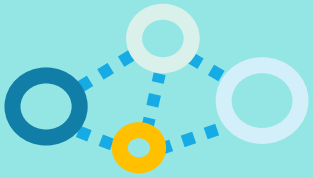
STRATEGIC PLAN

Complete | In Progress 2018 Target | Planned 2018-19 | Planned 2019-20

Priority 1: Developing

Develop a more robust HIRA methodology and framework through continuous improvement.

Priority 2: Connecting

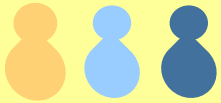


Improve understanding of complex Hazard and Risks through more targeted and focused assessment.

Priority 3: Integrating

Leverage overlapping goals and objectives within the City of Toronto, to enhance and improve multiple projects.

Priority 4: Engaging



Work with stakeholders and partners to develop and enhance the HIRA with a whole-of-society approach.

STRATEGIC PLAN

Priority 1: Developing

Develop a more robust HIRA methodology and framework through continuous improvement.

Priority 1: Developing

Revisions to the HIRA since 2016 have focused on process improvements, such as defining service interruptions, understanding potential impact to critical infrastructure, and improving data collection and analysis.

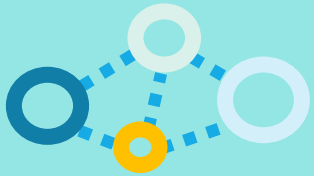
Over 480 hours of research work-hours, along with 200 staff hours at the Office of Emergency Management, have resulted in a well-documented and comprehensive baseline of research and analysis.

This assessment is based on establishing and assessing potential capacity in response to realistic worst-case scenarios, and is supported by a combination of interviews, research and peer review with Subject Matter Experts. This product, along with a number of supporting guides, now serve to bolster institutional knowledge, guide policy, and inform plans in the Office of Emergency Management and across institutional barriers.

STRATEGIC PLAN

In Progress
2018 Target

Priority 2: Connecting



Improve understanding of complex Hazard and Risks through more targeted and focused assessment.

Priority 2: Connecting

1. Improve understandings of interdependency of Critical Infrastructure

2. Further develop hazard-specific assessment in three core areas, contributing to risk mitigation measures:
   - Cyber Threat
   - Electrical Power Disruption
   - Flooding

3. Assess and improve the way in which Hazard Identification and Risk Assessment informs program areas within the Office of Emergency Management and the EMWG.

THE CITY OF TORONTO

OFFICE OF EMERGENCY MANAGEMENT

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