

Hazard Identification and Risk Analysis

City of Whitehorse 2017



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This HIRA is a qualitative accounting and assessment of hazard likelihood and consequence in the City of Whitehorse. The HIRA process was conducted with collaboration between City of Whitehorse Staff, First Responders, Local Industry, and Territorial and Federal agencies and was facilitated by Calian.





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December 21, 2017



1. Disclaimer

This information is the property of the City of Whitehorse and is intended to be used by the City of Whitehorse, its staff, and stakeholders for the purpose of risk mitigation and emergency management planning. Information and data used in the compilation of this report has been gathered from various sources made available by the City of Whitehorse. These include:

- City of Whitehorse Fire Department
- City Managers and Staff
- Yukon Emergency Measures Organization
- Yukon Wildland Fire Management
- Whitehorse Airport Authority
- Yukon Energy
- Local fuel shipping and storage companies

The information in this Hazard Assessment and Risk Assessment (HIRA) is the result of Calian applying its professional expertise and professional opinion to the information available. As such, the accuracy of all findings is subject to the accuracy of the data set. Furthermore, it must be expected that hazard conditions will continue to evolve and be influenced positively and negatively by many factors. It is recommended that this analysis be revisited regularly and undergo a complete update on 5 year cycles.

Any user of this information accepts responsibility for any and errors and omissions.

2. Executive Summary

This HIRA is a qualitative examination of the Likelihood, Consequence and Risk of specific hazard types as they relate to the City of Whitehorse. The project team responsible to gathering and assessing the risk data was comprised of members from various city departments, the Yukon Government, and RCMP. The HIRA methodology, facilitation of all client and stakeholder interactions, and final assessment of hazard information was completed by Calian.

The HIRA has identified 28 hazard types with the potential to impact the city. This list is not exhaustive and cannot be considered a total accounting of all risks and hazards. In addition, the compounding of several hazards can significantly modify the impact or risk associated with a hazard. This hazard list is well suited to aid city decision makers in their work to provide emergency management and response services to the city and for prioritization of mitigation efforts.



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The hazard types have been split into 2 groups; Natural Hazards, and Human/Technological Hazards. The most significant risks in each group are:

Natural Hazards	Human/Technological Hazards
Urban Interface Fire	HAZMAT
Extreme Cold	Structure Fire
Earthquake – Major	Road Transportation Emergency

For each hazard type some possible mitigation efforts or "Risk Treatments" have been identified and briefly described. These Risk Treatments include:

- Planning activities
 - Response Planning
 - Crisis Communications Planning
 - Evacuation Planning
- Emergency Exercises
- Maintenance and improvement of systems and infrastructure
- Quantitative analysis of specific issues
- Site familiarization for first responders

3. Introduction

Identifying and measuring risk against realistic metrics is an important step in establishment and maintenance of a comprehensive Emergency Management Program. Completing this process and taking appropriate planning and development actions will enable an organization to mitigate hazards where possible, prepare response and management programs to take action, respond safely and effectively, and recover with minimal disruption and loss. In short, a HIRA enables an organization to improve their overall resiliency.

Calian's HIRA is an accounting and qualitative measure hazard of impact on a community or organization. It takes into account many information streams including historic accounting of incident frequency and severity, traditional knowledge of local and indigenous peoples, professional opinion of response organizations, and industry best practice. A complete and current HIRA can be used as one tool to assist city leaders and responders prepare for and take action to prevent serious and costly emergency actions.



4. Methodology

Calian has used a collaborative approach to work with representatives from the City of Whitehorse to analyze and prioritize the hazard landscape based on local resources and priorities. This approach also identified high level recommendations associated with preparing for the most intense and imminent risks. This approach has proven to be successful in maximizing productivity while also passing on development knowledge to the stakeholders engaged in the project.

First, Calian conducted an online workshop to prepare the City of Whitehorse staff and assign data collection tasks. Data collection provided the basis of the hazard landscape assessment that was further explored throughout development of the HIRA. This process included an examination of both natural and human caused or technological hazards that have, or could potentially impact the City of Whitehorse. This process involved a qualitative examination of historical data relating to regularly occurring events such as floods and wildfires, but also an investigation of existing technological features within the City, such as transportation routes, critical infrastructure, and hazardous materials sites. By examining these features, the team has determined the breadth of hazard impacts that could potentially impact the City of Whitehorse.

Second, stakeholder engagement sessions and site visits were completed in order to collect local knowledge and additional context regarding hazards and risk. These engagement sessions included interviews with relevant stakeholders who could potentially play a key role in emergency management. These sessions provide information critical to understanding the local hazard landscape, and provide context for future analysis relating to the risk posed by potential hazards.

Third, two on site workshops were facilitated to explore potential hazards and assign qualitative consequence and likelihood scores. Copies of the hazard analysis worksheets are in Appendix A of this report. These scores were then used to calculate risk. Specifics regarding the Likelihood, Consequence, and Risk Scores are in Appendix B of this report.

Finally, the data and stakeholder inputs collected have been analyzed and reviewed. The hazards have been described, hazard treatments recommended, and risk data has been presented in a hazard landscape chart.



5. Modifiers

There are a number of factors which have the potential to influence the risk score. These factors have not been fully integrated in the assessment of risk and should be considered in planning and mitigation efforts. These factors have a particular effect when multiple hazards are combined in a single incident scenario.

- Remote community
 - While the City of Whitehorse is well serviced by ground and air transportation routes, these routes are vulnerable to interruption by several hazards. Additionally, the distances and travel times to and from the City of Whitehorse result in a logistical issue for the safe evacuation of people from the area and the provision of support from other jurisdictions.
- Dependency of other Yukon communities
 - As the primary urban centre in the Yukon Territory, the City of Whitehorse will be a focal point for disasters with consequences with territorial reach. It should be expected that citizens of other Yukon communities will fall back to Whitehorse for support during an emergency. This influx of people, while likely being supported by EMO, should be considered an additional vulnerable population within the city.
- Resource availability
 - Due to the remoteness of the City of Yukon, replenishment of emergency resources and personnel can be delayed. This can result in limitations to the response to and recovery from emergencies and disasters.



6. Hazard Landscape

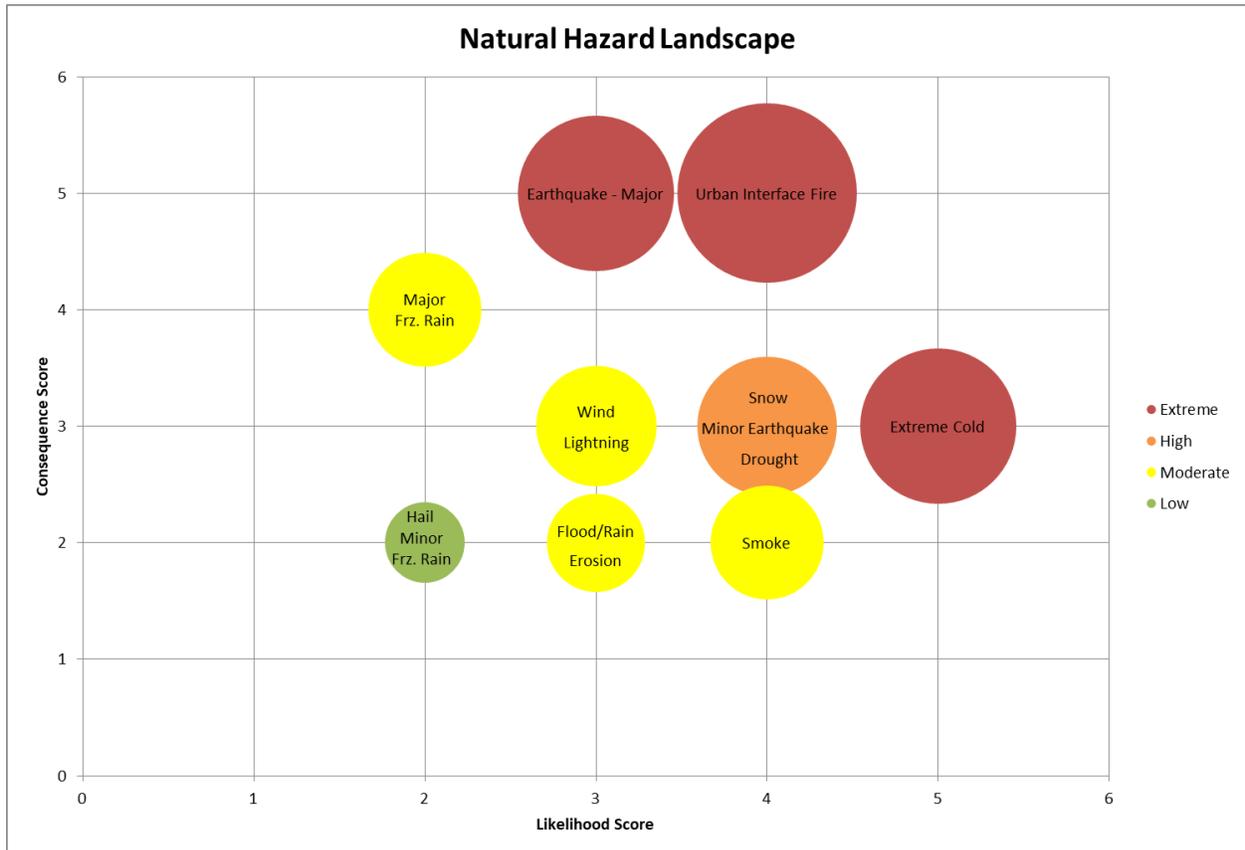
The table below displays natural hazards ranked by Risk Score. This information provides a quick reference and is supplemental to the hazard descriptions found in Appendix A and possible risk treatments described in section 7. It may not be practical or possible to address these risks in this order. The Risk Score should not be used as a sole means of prioritization.

Natural Hazard Landscape Table			
Hazard	Likelihood	Consequence	Risk
Urban Interface Fire	4	5	20
Extreme Cold	5	3	15
Earthquake - Major	3	5	15
Snow/Blizzard	4	3	12
Drought	4	3	12
Earthquake - Minor	4	3	12
Wind Events	3	3	9
Lightning	3	3	9
Freezing Rain - Major	2	4	8
Smoke	4	2	8
Flood/Rain	3	2	6
Erosion	3	2	6
Hail	2	2	4
Freezing Rain - Minor	2	2	4



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The chart below is supplemental to the Natural Hazards Landscape Table. On this chart the Natural Hazards Risk Score is displayed according to position on the chart with Likelihood on the X axis and Consequence on the Y axis. The size of the data point represents the magnitude of the risk and the colour represents the risk category (Nil to Extreme).





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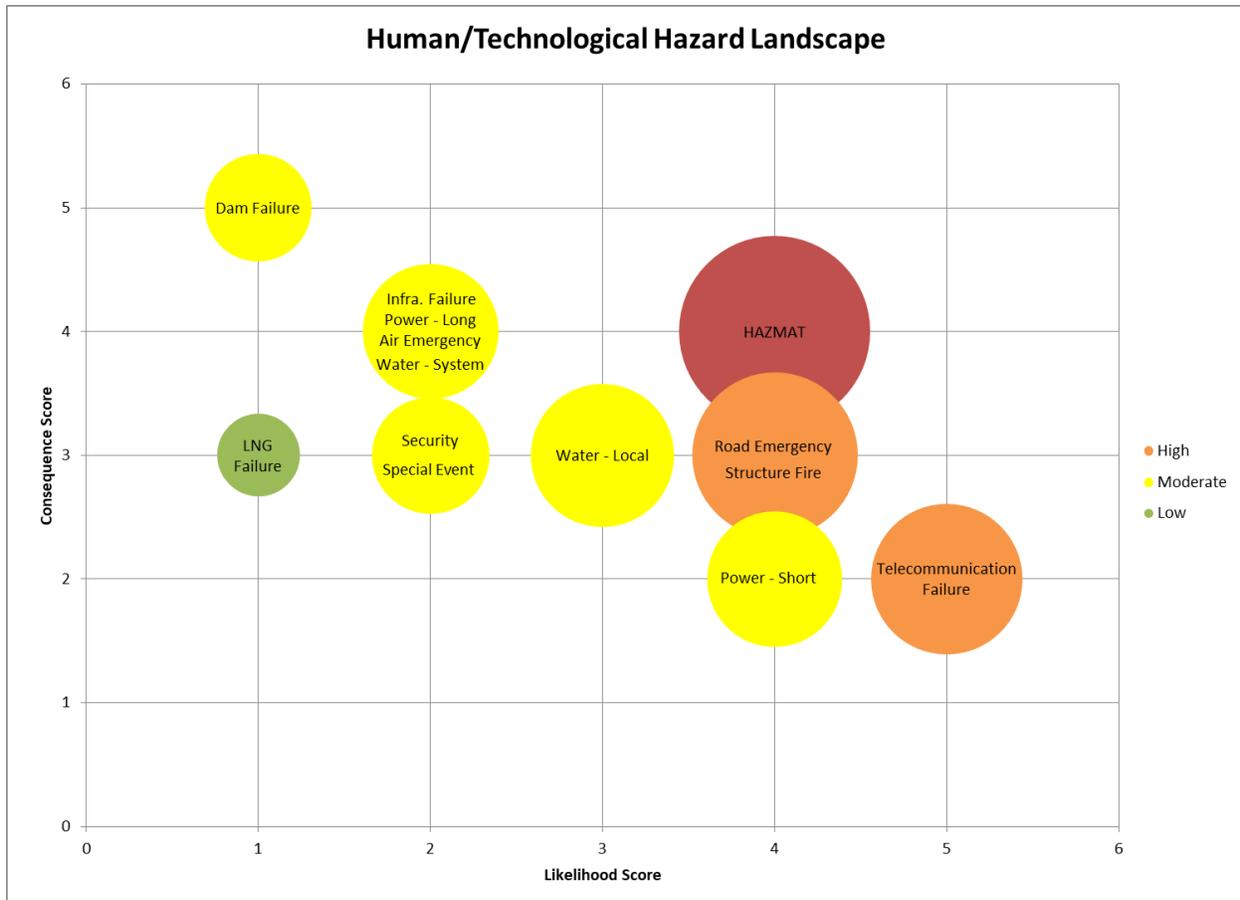
Similar to the Natural Hazard Landscape Table above, the table below displays Human/Technological hazards ranked by Risk Score. This information provides a quick reference and is supplemental to the hazard descriptions found in Appendix A and possible risk treatments described in section 7. It may not be practical or possible to address these risks in this order. The risk Score should not be used as a sole means of prioritization.

Human/Technological Hazard Landscape			
Hazard	Likelihood	Consequence	Risk
HAZMAT	4	4	16
Structure Fire	4	3	12
Road Transportation Emergency	4	3	12
Telecommunications Failure	5	2	10
Localized Water Emergency	3	3	9
Power Failure - Short	4	2	8
Infrastructure Failure	2	4	8
Power Failure - Long	2	4	8
Air Transportation Emergency	2	4	8
System Wide Water Emergency	2	4	8
National Security Incident	2	3	6
Special Events	2	3	6
Dam Failure	1	5	5
LNG Plant Failure	1	3	3



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Similar to the Natural Hazard Landscape Chart above, the chart below is supplemental to the Human/Technological Hazards Landscape Table. On this chart the Human/Technological Hazards Risk Score is displayed according to position on the chart with Likelihood on the X axis and Consequence on the Y axis. The size of the data point represents the magnitude of the risk and the colour represents the risk category (Nil to Extreme).





7. Possible Risk Treatments

The preceding sections have described the hazard landscape of the city of Whitehorse. This section identifies the Risk Strategy (see Appendix C for detail on Risk Strategies) and briefly outlines some possible actions, or Risk Treatments, which may be employed to reduce risk. In some cases multiple strategies are applicable.

Note: The Risk Treatments described here have not been assessed for budgetary or other practical conditions. Additional analysis should be completed to determine feasibility of these treatments and priority for implementation.

1. Flood/Rain: Reduce

- a. Surface drainage modifications
 - i. Storm drain and surface water management systems can be assessed by various means to determine optimum configuration. Subsequently, through modification to the water management systems a risk reduction may be possible.
- b. Maintenance of current drainage systems
 - i. Maintenance and clearing of current surface water management systems will maintain current ability and reduce possibility of increasing risk.

2. Snow/Blizzard: Contingency

- a. Response vehicle preparedness
 - i. Ensure adequate capacity to work and maneuver in adverse conditions.
- b. Business Continuity Planning
 - i. BCP can include provisions for staff to work from home under defined conditions.
- c. Snow removal policy/analysis
 - i. Current strategy should be shared with the EOC in order to inform operational picture during operations. Regular assessment and revision of the policy should be conducted in order to maintain currency.
- d. Transit/Emergency route prioritization
 - i. Current strategy should be shared with the EOC in order to inform operational picture during operations. Regular assessment and revision of the policy should be conducted in order to maintain currency



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- e. Engineered solutions
 - i. Installation of engineered solutions such as snow fencing to reduce impacts on roads and other critical areas.

- 3. **Hail: Transfer**
 - a. Insurance
 - i. Ensure adequate coverage for this hazard and/or accept liability for damage to property.

- 4. **Freezing Rain – Minor: Contingency**
 - a. Response vehicle preparedness
 - i. Ensure adequate capacity to work and maneuver in adverse conditions.
 - b. Response planning
 - i. Current strategies should be shared with the EOC in order to inform operational picture during operations. As necessary new planning documents should be created. Regular assessment and revision of the plans should be conducted in order to maintain currency.

- 5. **Freezing Rain – Major: Contingency**
 - a. Response vehicle preparedness
 - i. Ensure adequate capacity to work and maneuver in adverse conditions.
 - b. Response planning
 - i. Current strategies should be shared with the EOC in order to inform operational picture during operations. As necessary new planning documents should be created. Regular assessment and revision of the plans should be conducted in order to maintain currency.
 - c. Infrastructure impact analysis
 - i. Conduct a focused study to determine impact to the city and implement recommendations.
 - d. Exercise
 - i. Design and deliver an exercise focused on this hazard. Measure results and implement recommendations from the After Action Report.



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6. Extreme Cold: Contingency

- a. ESS and health/social planning
 - i. Assess and plan for provision of support to vulnerable populations. Prepare the city to provide warming shelters to support vulnerable populations.
- b. Collaboration with other agencies (EMO)
 - i. Determine the jurisdictional and mutual aid relationships required to successfully support citizens susceptible to cold.

7. Wind Events: Contingency

- a. Road clearing prioritization
 - i. Identify locations susceptible to blockage from downed trees and make plans for prioritization of clearing.
- b. Power grid planning
 - i. Identify locations susceptible to damage from downed trees and make plans for prioritization of clearing.

8. Drought: Contingency

- a. Forest fuel treatments & FireSmart
 - i. Increase participation in and support for fuel reduction programs. This may include fuel thinning projects, prescribed burning, clearing of strategic fire breaks and access roads/trails, use of FireSmart building materials.
- b. Fire bans
 - i. Strategic issuance of fire restrictions.
- c. Water usage planning
 - i. Development of water usage restriction policy to be implemented if/when severe conditions result in water supply reserves.

9. Urban Interface Fire: Reduce, Contingency, Transfer

- a. Quantitative analysis
 - i. Conduct a focused study to determine impact to the city and implement recommendations.
- b. Forest fuel treatments & FireSmart
 - i. Increase participation in and support for fuel reduction programs. This may include fuel thinning projects, prescribed burning, clearing of strategic fire breaks and access roads/trails, use of FireSmart building materials.
- c. Fire bans
 - i. Strategic issuance of fire restrictions.
- d. Response planning
 - i. Current strategies should be shared with the EOC in order to inform operational picture during operations. As necessary new planning



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documents should be created. Regular assessment and revision of the plans should be conducted in order to maintain currency.

- e. Exercise
 - i. Design and deliver an exercise focused on this hazard. Measure results and implement recommendations from the After Action Report.
- f. Evacuation planning
 - i. Develop an intermodal evacuation plan that emphasizes the use of existing primary ground transportation routes but also leverages alternate means of transportation including secondary roads, air transport, Alaska State Ferry, and other methods. Such a plan should have the capacity to guide the evacuation of all residents in response to a significant incident.
- g. Crisis communications planning
 - i. Creation of a comprehensive crisis communication plan focused on primary messaging and emergency communications designed to support and work in alignment with other city wide communications initiatives.

10. Smoke: *Contingency, Accept*

- a. Medical transport planning
 - i. Coordinate with EMS to determine alternate means for medical transport to the Whitehorse hospital and out of the Territory.
- b. Public health warnings
 - i. Strategic issuance of public health messages.

11. Erosion: *Contingency*

- a. Quantitative analysis
 - i. Conduct a focused study to determine impact to the city and implement recommendations.
- b. Purchase of vulnerable property
 - i. As appropriate, purchase or expropriate properties located in slide areas or at risk to loss due to erosion.
- c. Land use planning
 - i. Modify land use policy and by-laws to exclude new construction in vulnerable areas.

12. Earthquake – Minor: *Contingency*

- a. Response planning
 - i. Current strategies should be shared with the EOC in order to inform operational picture during operations. As necessary new planning documents should be created. Regular assessment and revision of the plans should be conducted in order to maintain currency.



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- b. Building codes revisions
 - i. Revise codes as required to maintain validity of construction practices to mitigate this hazard.
- c. Exercise
 - i. Design and deliver an exercise focused on this hazard. Measure results and implement recommendations from the After Action Report.
- d. Business Continuity Planning
 - i. Complete a city BCP to identify critical personnel and resources and provide plausible methods to restore and continue city functions.
- e. ESS planning
 - i. Current strategies should be shared with the EOC in order to inform operational picture during operations. As necessary new planning documents should be created. Regular assessment and revision of the plans should be conducted in order to maintain currency.
- f. Facility evacuation planning
 - i. Create evacuation, rapid damage assessment, and re-entry plans for all city and critical infrastructure.
- g. Crisis communications planning
 - i. Creation of a comprehensive crisis communication plan focused on primary messaging and emergency communications designed to support and work in alignment with other city wide communications initiatives.

13. Earthquake – Major: Contingency

- a. Response planning
 - i. Current strategies should be shared with the EOC in order to inform operational picture during operations. As necessary new planning documents should be created. Regular assessment and revision of the plans should be conducted in order to maintain currency.
- b. Building codes revisions
 - i. Revise codes as required to maintain validity of construction practices to mitigate this hazard.
- c. Exercise
 - i. Design and deliver an exercise focused on this hazard. Measure results and implement recommendations from the After Action Report.
- d. Business Continuity Planning
 - i. Complete a city BCP to identify critical personnel and resources and provide plausible methods to restore and continue city functions.



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- e. ESS planning
 - i. Current strategies should be shared with the EOC in order to inform operational picture during operations. As necessary new planning documents should be created. Regular assessment and revision of the plans should be conducted in order to maintain currency.
- f. Evacuation planning
 - i. Develop an intermodal evacuation plan that emphasizes the use of existing primary ground transportation routes but also leverages alternate means of transportation including secondary roads, air transport, Alaska State Ferry, and other methods. Such a plan should have the capacity to guide the evacuation of all residents in response to a significant incident.
- g. Facility evacuation planning
 - i. Create evacuation, rapid damage assessment, and re-entry plans for all city and critical infrastructure.
- h. Crisis communications planning
 - i. Creation of a comprehensive crisis communication plan focused on primary messaging and emergency communications designed to support and work in alignment with other city wide communications initiatives.

14. Lightning: *Accept*

- a. Code enforcement
 - i. Maintain and enforce relevant fire and building codes.
- b. Treatment options for related hazards (fire, power failure, etc.) described elsewhere

15. Infrastructure Failure: *Contingency*

- a. Alternate transport route planning
 - i. Ascertain and test alternate transportation routes. This should be linked to efforts in evacuation planning.
- b. Response planning
 - i. Current strategies should be shared with the EOC in order to inform operational picture during operations. As necessary new planning documents should be created. Regular assessment and revision of the plans should be conducted in order to maintain currency.
- c. Crisis communications planning
 - i. Creation of a comprehensive crisis communication plan focused on primary messaging and emergency communications designed to support and work in alignment with other city wide communications initiatives.



16. Dam Failure: Contingency

- a. Interagency cooperation
 - i. Determine the jurisdictional and mutual aid relationships required to successfully implement a response and evacuation plan.

- b. Response planning
 - i. Current strategies should be shared with the EOC in order to inform operational picture during operations. As necessary new planning documents should be created. Regular assessment and revision of the plans should be conducted in order to maintain currency.
- c. Evacuation planning
 - i. Develop an intermodal evacuation plan that emphasizes the use of existing primary ground transportation routes but also leverages alternate means of transportation including secondary roads, air transport, Alaska State Ferry, and other methods. Such a plan should have the capacity to guide the evacuation of all residents in response to a significant incident.
- d. Exercise
 - i. Design and deliver an exercise focused on this hazard. Measure results and implement recommendations from the After Action Report.
- e. Crisis communications planning
 - i. Creation of a comprehensive crisis communication plan focused on primary messaging and emergency communications designed to support and work in alignment with other city wide communications initiatives.

17. LNG Plant Failure: Contingency

- a. Response planning
 - i. Current strategies should be shared with the EOC in order to inform operational picture during operations. As necessary new planning documents should be created. Regular assessment and revision of the plans should be conducted in order to maintain currency.
- b. Familiarization for public and responders
 - i. Provide opportunities for site and hazard familiarization for first responders.
- c. Crisis communications planning
 - i. Creation of a comprehensive crisis communication plan focused on primary messaging and emergency communications designed to



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support and work in alignment with other city wide communications initiatives.

18. Power Failure – Short: *Accept*

- a. Personal Preparedness
 - i. Citizens should make preparations for self-sufficiency.

19. Power Failure – Long: *Contingency*

- a. ESS and other social planning
 - i. Assess and plan for provision of support to vulnerable populations. Prepare the city to provide warming shelters to support vulnerable populations.
- b. Exercise
 - i. Design and deliver an exercise focused on this hazard. Measure results and implement recommendations from the After Action Report.

20. Structural Fire: *Reduce, Contingency*

- a. Prevention planning
 - i. Support and improve current fire prevention capacity in order to reduce risk of ignition.
- b. Impact analysis
 - i. Conduct a focused study to determine possibility of running fire spread and impact to the city; implement recommendations.
- c. Code enforcement
 - i. Maintain and enforce relevant fire and building codes.
- d. Exercise
 - i. Design and deliver an exercise focused on this hazard. Measure results and implement recommendations from the After Action Report.

21. HAZMAT: *Contingency, Reduce*

- a. Complete quantitative hazard analysis
 - i. Conduct a focused study to determine impact to the city and implement recommendations.
- b. Exercise
 - i. Design and deliver an exercise focused on this hazard. Measure results and implement recommendations from the After Action Report.
- c. Responder familiarization
 - i. Provide opportunities for site and hazard familiarization for first responders.
- d. Response planning



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- i. Current strategies should be shared with the EOC in order to inform operational picture during operations. As necessary new planning documents should be created. Regular assessment and revision of the plans should be conducted in order to maintain currency.
- e. Code enforcement
 - i. Examine facilities and enforce code adherence.
- f. Crisis communications planning
 - i. Creation of a comprehensive crisis communication plan focused on primary messaging and emergency communications designed to support and work in alignment with other city wide communications initiatives.

22. National Security Incident: *Contingency*

- a. Interagency support planning
 - i. Determine the jurisdictional and mutual aid relationships required and make plans for joint support operations.
- b. Exercise
 - i. Design and deliver an exercise focused on this hazard. Measure results and implement recommendations from the After Action Report.
- c. Crisis communications planning
 - i. Creation of a comprehensive crisis communication plan focused on primary messaging and emergency communications designed to support and work in alignment with other city wide communications initiatives.

23. Air Transportation Emergency: *Contingency*

- a. Response Planning
 - i. Current strategies should be shared with the EOC in order to inform operational picture during operations. As necessary new planning documents should be created. Regular assessment and revision of the plans should be conducted in order to maintain currency.
- b. Exercise
 - i. Design and deliver an exercise focused on this hazard. Measure results and implement recommendations from the After Action Report.
- c. Crisis communications planning
 - i. Creation of a comprehensive crisis communication plan focused on primary messaging and emergency communications designed to support and work in alignment with other city wide communications initiatives.



24. Telecommunications Failure: Contingency

- a. Public knowledge of alternate 911
 - i. Public messaging of procedures and methods for contacting emergency services during telecommunications can reduce public safety consequences
- b. Business Continuity Planning
 - i. Complete a city BCP to identify critical personnel and resources and provide plausible methods to restore and continue city functions.

25. Road Transportation Emergency: Contingency

- a. Business continuity planning
 - i. Complete a city BCP to identify critical personnel and resources and provide plausible methods to restore and continue city functions.
- b. Response planning
 - i. Current strategies should be shared with the EOC in order to inform operational picture during operations. As necessary new planning documents should be created. Regular assessment and revision of the plans should be conducted in order to maintain currency
- c. Exercise
 - i. Design and deliver an exercise focused on this hazard. Measure results and implement recommendations from the After Action Report.

26. Drinking Water Emergency - Localized: Contingency

- a. Engineering assessment
 - i. The city undergoes periodic engineering assessments of the water treatment and delivery system. These assessments should continue and the frequency of assessment should be assessed and validated by a qualified engineering firm. Recommendations from these assessments should be implemented to maintain currency and reduce risk.
- b. Ongoing maintenance and improvement
 - i. Support and increase support to system maintenance and improvement initiatives.
- c. Crisis communications planning
 - i. Creation of a comprehensive crisis communication plan focused on primary messaging and emergency communications designed to



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support and work in alignment with other city wide communications initiatives.

- d. Business Continuity Planning
 - i. Complete a city BCP to identify critical personnel and resources and provide plausible methods to restore and continue city functions.

27. Drinking Water Emergency – System Wide: Contingency

- a. Engineering assessment
 - i. The city undergoes periodic engineering assessments of the water treatment and delivery system. These assessments should continue and the frequency of assessment should be assessed and validated by a qualified engineering firm. Recommendations from these assessments should be implemented to maintain currency and reduce risk.
- b. Ongoing maintenance and improvement
 - i. Support and increase support to system maintenance and improvement initiatives.
- c. Crisis communications planning
 - i. Creation of a comprehensive crisis communication plan focused on primary messaging and emergency communications designed to support and work in alignment with other city wide communications initiatives.
- d. Business Continuity Planning
 - i. Complete a city BCP to identify critical personnel and resources and provide plausible methods to restore and continue city functions.

28. Special Events: Contingency

- a. Event Planning
 - i. Create a capacity to provide cross city support to high profile events. Such a capacity should have a basis in ICS and include cross jurisdictional participation.
- b. Support to community organizers
 - i. Provide guidance and support to local community groups who undertake the planning and operation of large events which draw participants from across the territory and beyond.
- c. Crisis communications planning
 - i. Creation of a comprehensive crisis communication plan focused on primary messaging and emergency communications designed to support and work in alignment with other city wide communications initiatives.



8. Appendix A – Risk Analysis Worksheets

No.	Hazard Group	Hazard Description	Scenario, Impacts, and Vulnerabilities	Likelihood Score	Consequence Score	Risk Response	Risk Treatment Options
1	Flood/Rain	Overland flooding	<ul style="list-style-type: none"> Minor flooding to residential streets due to spring thaw result in water back up and short term road issues due to overwhelmed storm drain system. <p>Vulnerabilities: Street access, minor building floods possible</p>	3	2	Reduce	<ul style="list-style-type: none"> Surface drainage modifications Maintenance of current drainage systems
2	Snow or Blizzard	Access issues	<ul style="list-style-type: none"> Emergency response vehicle access delays can increase response time and can impact ability to provide critical services. Personal vehicle access restrictions can reduce ability of citizens to utilize roads in some areas. Without assistance, vulnerable populations may be unable to access resources resulting in shortage of medical or other priority services. City staff may be unable to get to worksite leading to service interruptions. Warming results in soft snow pack and runoff leading to potential for drainage systems overload. <p>Vulnerabilities: Road access, loss of service,</p>	4	3	Contingency	<ul style="list-style-type: none"> Snow removal policy/analysis Transit/Emergency route prioritization Engineered solutions



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No.	Hazard Group	Hazard Description	Scenario, Impacts, and Vulnerabilities	Likelihood Score	Consequence Score	Risk Response	Risk Treatment Options
			delays				
3	Hail	Small to mid-size hail	<ul style="list-style-type: none"> Minor isolated property damage, not a significant issue from a city EM perspective. <p>Vulnerabilities: Damage to exposed surfaces</p>	2	2	Transfer	<ul style="list-style-type: none"> Insurance issue
4	Freezing Rain – Minor	Light to moderate accumulation	<ul style="list-style-type: none"> Poor road condition resulting in multiple vehicle accidents and localized property damage <p>Vulnerabilities: Road access, increase in response times</p>	2	2	Contingency	<ul style="list-style-type: none"> Response planning
5	Freezing Rain – Major	Moderate to heavy accumulation	<ul style="list-style-type: none"> Utility failure, road closure, communication failures, infrastructure damage (transmission lines, towers, etc.), resulting in loss of power for extended periods of time, road access issues, food security, and financial implications. <p>Vulnerabilities: Road access, collapse of transmission lines, structure damage, vegetation damage</p>	2	4	Contingency	<ul style="list-style-type: none"> Response planning Infrastructure impact analysis Exercise
6	Extreme Cold	Low temperatures and wind chill	<ul style="list-style-type: none"> Vulnerable populations in need of support could be impacted. Difficulty in water supply for firefighting can result in capability limitations. 	5	3	Contingency	<ul style="list-style-type: none"> ESS and health/social planning Collaboration with



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No.	Hazard Group	Hazard Description	Scenario, Impacts, and Vulnerabilities	Likelihood Score	Consequence Score	Risk Response	Risk Treatment Options
			<ul style="list-style-type: none"> Other emergency response capacities can be impacted resulting reduced service. <p>Vulnerabilities: Medical emergencies from exposure, equipment failures, delay in response time</p>				<ul style="list-style-type: none"> other agencies (EMO) Warming shelters Transit planning
7	Wind Events	Microburst and/or high wind	<ul style="list-style-type: none"> Localized impact to power grid and other utilities resulting in power loss and potential for wildfire ignition. Damage to trees and other City assets or features. Forest Fuel loading and damage to FireSmart treatment areas. <p>Vulnerabilities: Damage to electrical lines, damage to structure, damage to vegetation , road access limitations</p>	3	3	Contingency	<ul style="list-style-type: none"> Road clearing prioritization Power grid planning
8	Drought	Low precipitation in summer and winter	<ul style="list-style-type: none"> Reduced residual moisture content can increase in spring fire hazard leading to early fast moving wildfire/interface fire and smoke. Results in reduced residual moisture content and an ongoing fire hazard with greater intensity. This can lead to intense fire conditions (see wildfire/interface fire, smoke) 	4	3	Contingency	<ul style="list-style-type: none"> Forest fuel treatments & FireSmart Fire bans Water usage planning



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No.	Hazard Group	Hazard Description	Scenario, Impacts, and Vulnerabilities	Likelihood Score	Consequence Score	Risk Response	Risk Treatment Options
			<ul style="list-style-type: none"> Dust on roads can lead to reduced visibility leading to vehicle accidents. Extreme cases may result in depletion of city water supply. <p>Vulnerabilities: Road speed reduction, delays, increased fire risk</p>				
9	Urban Interface Fire	Fire spreading in forest and structural fuels within city limits	<ul style="list-style-type: none"> Wildfire enters a residential area and spreads rapidly resulting in widespread residential structure destruction. Wildfire burning in track of forest land inside city limits or in proximity to the city resulting in smoke and potential for loss of residential or other property. Requirement for large scale evacuation. <p>Vulnerabilities: Access/egress routes, Hospital damage or reduction in capacity, fuel loading in proximity to structures, fire vulnerable building materials in use, evacuation plan not in place, public not uniformly active in FireSmart programming</p>	4	5	Reduce Contingency Transfer	<ul style="list-style-type: none"> Forest fuel treatments & FireSmart Controlled burning Response planning Exercise Access routes planning Evacuation planning Crisis communications planning
10	Smoke	Reduced air quality	<ul style="list-style-type: none"> Smoke from wildfires (sometimes distant) 	4	2	Contingency	<ul style="list-style-type: none"> Medical transport



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No.	Hazard Group	Hazard Description	Scenario, Impacts, and Vulnerabilities	Likelihood Score	Consequence Score	Risk Response	Risk Treatment Options
			<p>from the city) can create poor air quality. Persons may experience negative health effects</p> <ul style="list-style-type: none"> • Reduced visibility may result in closure or limitations to aircraft and road traffic. <p>Vulnerabilities: Impacts on evacuation methods, personal health, care facilities, visibility, tourism operations</p>			Accept	<p>planning</p> <ul style="list-style-type: none"> • Evacuation planning • Public health warnings
11	Erosion	<p>Removal or sliding of soils and other material in various locations including:</p> <ul style="list-style-type: none"> • Yukon River banks • Cliffs below airport 	<ul style="list-style-type: none"> • Constant removal of material can result in minor issues and loss of land. Minimal impact on the city from destruction of trails and other recreational use. • Blockage of the Robert Service Way could result in limited EM response, would prevent efficient evacuation, can affect power generation and transmission due to access to Yukon Energy sites. • Potential for impact to airport operations. • Minor impacts to other recreational and residential areas • Bank erosion can impact multiple sites including First Nations cultural site (burial site), residences, and recreation trails. <p>Vulnerabilities: Damage to cultural sites, damage to structures, road access limitations</p>	3	3	Reduce	<ul style="list-style-type: none"> • Purchase of vulnerable property • Land use planning (OCP)



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No.	Hazard Group	Hazard Description	Scenario, Impacts, and Vulnerabilities	Likelihood Score	Consequence Score	Risk Response	Risk Treatment Options
12	Earthquake - Minor	Short duration, mild intensity shaking	<ul style="list-style-type: none"> Glass breaks, residential damages, power outage due to safety shut down, landslides, limited building damage resulted in requirement to relocate staff, limited disruption to airport operations, public reaction of fear and uncertainty of infrastructure safety, disruption of service and loss of revenue, required recce of transport routes. <p>Vulnerabilities: Light infrastructure damage, delay in service, communications failures, public concern</p>	4	3	Contingency	<ul style="list-style-type: none"> Response planning Building codes revisions Exercise Business Continuity Planning ESS planning Facility evacuation planning Crisis communications planning
13	Earthquake – Major	Long duration intense shaking with potential for aftershocks	<ul style="list-style-type: none"> Catastrophic consequence including death and injury, serious structural and critical infrastructure damage. Trigger for other hazards such as power outage, structural collapse, and fire. <p>Vulnerabilities: population, structure, critical infrastructure, continuance of government services, financial</p>	3	5	Contingency	<ul style="list-style-type: none"> Response planning Building codes revisions Exercise Business Continuity Planning ESS planning Facility evacuation planning Crisis communications planning
14	Lightning	Lightning strike to	<ul style="list-style-type: none"> Wildfire starts or structural fires resulting 	4	3	Accept	<ul style="list-style-type: none"> Treatment options



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No.	Hazard Group	Hazard Description	Scenario, Impacts, and Vulnerabilities	Likelihood Score	Consequence Score	Risk Response	Risk Treatment Options
		structure or forest fuels	<p>from strikes.</p> <ul style="list-style-type: none"> Transformer or other infrastructure damage resulting in localized power loss. <p>Vulnerabilities: Ungrounded or otherwise protected systems and structures, forest fuels</p>				for related hazards described elsewhere
15	Infrastructure Failure	Loss of structure critical to city functions, most likely as a result of another hazard	<ul style="list-style-type: none"> Access loss from compromise of Robert Campbell bridge would result in need to transport patients to and from by alternate means. Erosion of river bank could have minor effects on hospital grounds. Due to any hazard impact, loss of airport operations would result in delay of transport of material and people. <p>Vulnerabilities: Bridges, towers and transmission structures, other infrastructure</p>	2	4	Contingency	<ul style="list-style-type: none"> Alternate transport route Emergency response planning Crisis communications planning
16	Dam Failure	Flood	<ul style="list-style-type: none"> Breach of the dam is a low probability event requiring significant hazard interaction such as a very strong earthquake or human/deliberate act. <p>Vulnerabilities: All population and infrastructure in the downtown core. Refer to Yukon Energy flood inundation analysis.</p>	1	5	Contingency	<ul style="list-style-type: none"> Interagency cooperation Response planning Evacuation planning Exercise Crisis communications planning



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No.	Hazard Group	Hazard Description	Scenario, Impacts, and Vulnerabilities	Likelihood Score	Consequence Score	Risk Response	Risk Treatment Options
17	LNG Plant Failure	Loss of fuel containment	<ul style="list-style-type: none"> LNG is a relatively non-volatile product. The LNG site has been engineered to manage and dissipate releases of LNG to the environment. Infrastructure is new and regulated to a high standard of care. A leak could have local impacts on Robert Service Way, Airport, Riverdale, possibly requiring localized evacuation depending on conditions. <p>Vulnerabilities: Road closures, local population</p>	1	3	Contingency	<ul style="list-style-type: none"> Response planning Familiarization for public and responders Crisis communications planning
18	Power Failure - Short	Loss of power for less than 1 day	<ul style="list-style-type: none"> Power generation is disrupted by a natural or human induced hazard can lead to loss of communications, heat and cooling issues, disruption of critical services. <p>Vulnerabilities: All infrastructure requiring constant electrical power</p>	4	2	Accept	<ul style="list-style-type: none"> Personal preparedness
19	Power Failure - Long	Loss of power for more than 1 day	<ul style="list-style-type: none"> Power generation is disrupted by a natural or human induced hazard can lead to loss of communications, heat and cooling issues, disruption of critical services. 	2	4	Contingency	<ul style="list-style-type: none"> ESS and other social planning Exercise Public awareness



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No.	Hazard Group	Hazard Description	Scenario, Impacts, and Vulnerabilities	Likelihood Score	Consequence Score	Risk Response	Risk Treatment Options
			Vulnerabilities: all infrastructure requiring constant electrical power				
20	Structural Fire	Residential and industrial fire	<p>Accidents and other issues managed by day to day emergency service operations. Development of municipal capacity to be measured and planned for outside the scope of this assessment.</p> <p>Vulnerabilities: All structures, linked infrastructure in downtown area</p>	4	3	Reduce Contingency	<ul style="list-style-type: none"> Prevention planning Impact analysis Code enforcement Exercise Public education
21	HAZMAT	<p>Dispersion of hazardous materials, handling facilities, and transportation routes throughout the city.</p> <p>Prominent HAZMAT types include:</p> <ul style="list-style-type: none"> Fuel transportation routes Chlorine & Ammonia used in recreation facilities and 	<ul style="list-style-type: none"> Accidents on roadway. Generally greater volume spilled on highway due to intensity of collision. Generally greater consequence in town due to proximity of population. The Alaska highway is the primary access for all ground shipments to and from Yukon and Alaska. This includes high volume fuel shipments, and undeclared military convoys. <p>Vulnerabilities: Environment, population, infrastructure</p> <ul style="list-style-type: none"> Various low volume placements of hazardous gas. These include CGC, skating rinks, curling. Most is stored in a secure/ventilated facility with alarmed monitoring. 	4	4	Contingency Reduce	<ul style="list-style-type: none"> Complete quantitative hazard analysis Exercise Responder familiarization Response planning Prevention Code enforcement Crisis communications planning



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No.	Hazard Group	Hazard Description	Scenario, Impacts, and Vulnerabilities	Likelihood Score	Consequence Score	Risk Response	Risk Treatment Options
		<p>water treatment</p> <ul style="list-style-type: none"> • Bulk propane facilities • Bulk fuel storage facilities • Landfill containing bulk above ground hazards (tires) • General use HAZMAT products at dispensing facilities, residences, and commercial buildings 	<p>Vulnerabilities: Close populations</p> <ul style="list-style-type: none"> • Various propane storage and sales facilities. Primary distribution centre is Super Save Propane with 4 horizontal storage and decanting tanks totaling a volume of 300,000lbs. Additional mobile tanks and tank trucks on site. New material is delivered via tank truck 1-2 times per week. Each delivery truck totals 60,000lbs. Shipments travel to Whitehorse on the Alaska Highway. <p>Vulnerabilities: Explosion hazard to all people and infrastructure in proximity to the site</p> <ul style="list-style-type: none"> • Significant fuel storage and distribution infrastructure in downtown industrial area. This includes up to 80M litres of product on an annual basis. Aging and non-compliant infrastructure limits control during an emergency. Fuels include various grades of: diesel, gasoline, jet, AvGas <p>Vulnerabilities: Any population or infrastructure in proximity to the site.</p>				



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No.	Hazard Group	Hazard Description	Scenario, Impacts, and Vulnerabilities	Likelihood Score	Consequence Score	Risk Response	Risk Treatment Options
			<p>Smoke, access issues, environment</p> <ul style="list-style-type: none"> Landfill contains HAZAMT storage facility and significant stockpile of tires. These materials, if ignited, present a smoke hazard for the city and have the possibility of releasing pollutants to the environment. Additionally, significant resources would be expended in the containment of the fire. <p>Vulnerabilities: Public health, response resources, environment</p> <ul style="list-style-type: none"> The population of Whitehorse has access to and stores quantities of HAZMAT. This includes personal use chemicals and fuel, fueling stations, and retailers. <p>Vulnerabilities: Within normal emergency response capacity</p> <ul style="list-style-type: none"> Various military convoys transit Whitehorse on the Alaska Highway. These shipments are not declared and are exempt from TDG regulations. <p>Vulnerabilities: Unexpected/unanticipated</p>				



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No.	Hazard Group	Hazard Description	Scenario, Impacts, and Vulnerabilities	Likelihood Score	Consequence Score	Risk Response	Risk Treatment Options
			TDG incidents, road access, increased risk to responders				
22	National Security Incident	Significant external event resulting in influx of people from air transportation routes or loss of ground transportation routes	<ul style="list-style-type: none"> • Circumstances outside of Whitehorse/Yukon can result in re-routing of aircraft to this airport. This would result in significant impact to city from influx of travelers. RCMP and other national security agencies will be activated under their plans. • Loss of ground transportation routes could result in stranded travelers seeking shelter in Whitehorse. <p>Vulnerabilities: Influx of vulnerable population</p>	2	3	Contingency	<ul style="list-style-type: none"> • Interagency support planning • Exercise • Crisis communications planning
23	Air Transportation Emergency	Air crash	<ul style="list-style-type: none"> • Flight path to runway is over significant sections of the city (including Yukon energy, EMO, Public Safety, Wildfire, recreation facility, residential). Air crash incident can result in damage to emergency facilities and a loss of capacity. • Topography can result in difficulty in response to runway overshoot incidents. 	2	4	Contingency	<ul style="list-style-type: none"> • Response Planning • Exercise • Crisis communications planning



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No.	Hazard Group	Hazard Description	Scenario, Impacts, and Vulnerabilities	Likelihood Score	Consequence Score	Risk Response	Risk Treatment Options
			Vulnerabilities: Death and injury, loss of service, damage to infrastructure				
24	Telecommunications Failure	Loss of communications capacity across landline and cellular phone networks and internet	<ul style="list-style-type: none"> All 3 media are frequently out of service. This results in public communication interruption and potential for loss of business systems. 911 can be impacted resulting in potential for delay in critical response activities in all service lines. There is a backup phone line for emergency services. Service interruptions can be short in duration (minutes) up to 4 days. <p>Vulnerabilities: loss of critical services (911), delay in response, public health</p>	5	2	Contingency	<ul style="list-style-type: none"> Public knowledge of alternate 911 Business Continuity Planning
25	Road Transportation Emergency	Closure of critical access, egress, and shipping routes	<ul style="list-style-type: none"> Significant ground shipping routes lost due to closure will result in shortage of supplies such as food, fuel, materials, medical supplies and patient transport. Accidents and other issues managed by day to day emergency service operations however, investigations can result in extended closures or limitations. Travellers can be stranded (vulnerable population) and require support. <p>Vulnerabilities: Food security, fuel security, vulnerable populations, evacuation capacity</p>	5	4	Contingency	<ul style="list-style-type: none"> Business continuity planning Response planning Evacuation planning Exercise Crisis communications planning
26	Drinking Water	<ul style="list-style-type: none"> Compromise of 	<ul style="list-style-type: none"> Public health issues surrounding water 	3	3	Contingency	<ul style="list-style-type: none"> Engineering



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No.	Hazard Group	Hazard Description	Scenario, Impacts, and Vulnerabilities	Likelihood Score	Consequence Score	Risk Response	Risk Treatment Options
	Emergency - Localized	water treatment and delivery system resulting in portability issue or inability to distribute drinking and /or fire water to a localized area of the city	<p>sanitation can result in severe consequences if undetected or uncommunicated.</p> <ul style="list-style-type: none"> • Delivery of fire water is a critical requirement for response and public safety. <p>Vulnerabilities: Trunk line configuration, susceptibility to other hazard types (fire, earthquake, HAZMAT), public consumption, response limitations</p>				<p>assessment</p> <ul style="list-style-type: none"> • Ongoing maintenance and improvement • Crisis communications planning • Business continuity planning
27	Drinking Water Emergency – System Wide	<ul style="list-style-type: none"> • Compromise of water treatment and delivery system resulting in portability issue or inability to distribute drinking and/or fire water across the system 	<ul style="list-style-type: none"> • Public health issues surrounding water sanitation can result in severe consequences if undetected or uncommunicated. • Delivery of fire water is a critical requirement for response and public safety. <p>Vulnerabilities: Trunk line configuration, susceptibility to other hazard types (fire, earthquake, HAZMAT), public consumption, response limitations</p>	4	4	Contingency	<ul style="list-style-type: none"> • Engineering assessment • Ongoing maintenance and improvement • Crisis communications planning • Business continuity planning
28	Special Events	Large gatherings, VIP visits, and transient/vulnerable populations	Influx of people participating in activities and events. Events can include national celebrations, VIP visits, local events (Quest, YRQ, airshow, various games), and tourism.	2	3	Contingency	<ul style="list-style-type: none"> • Event Planning • Support to Crisis communications planning



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No.	Hazard Group	Hazard Description	Scenario, Impacts, and Vulnerabilities	Likelihood Score	Consequence Score	Risk Response	Risk Treatment Options
			<p>Gatherings can lead to disorder incidents and vulnerability to intentional human acts. Interaction between a special event and another hazard type can lead to large numbers of people requiring assistance with no local support network.</p> <p>Vulnerabilities: Special or vulnerable populations</p>				<ul style="list-style-type: none"> community organizers



9. Appendix B – Score Matrix

Consequence Score:

A qualitative description of hazard magnitude to the population, culture, and environment ranked from 1 to 5 (Negligible to Catastrophic). Consequence scores take into account, loss of life and/or injury and illness, facility or infrastructure damage, service outages, environmental issues, and financial loss.

Consequence Score		
Score	Severity	Description
5	Catastrophic	Wide spread death and/or illness; Facilities permanently destroyed or disabled; Critical systems unavailable for extended periods; overwhelming financial implications; Other disastrous impact
4	Major	Some loss of life and/or illness reported; infrastructure impacted; Critical systems interrupted; significant financial impact; other major impact
3	Moderate	Hospitalization or injuries; localized damage to infrastructure; short term system interruption; moderate financial impact; other localized impacts
2	Minor	Medical treatments and minor injury; minor damages only; inconvenient system interruptions; some financial implications; other quickly resolved impacts
1	Negligible	Minor first aid incidents; no appreciable infrastructure impacts; negligible systems issues, resolved in day-to-day management; minimal financial loss;

Likelihood Score:

A qualitative description of probability regarding a specific hazard event being realized ranked from 1 to 5 (Rare to Almost Certain). Likelihood scores may take into account the historic rate of occurrence, traditional or local knowledge, specific local conditions, and predicted trends.



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Likelihood Score		
Score	Probability	Description
5	Almost Certain	Will undoubtedly happen or recur, possibly frequently
4	Likely	Will probably happen or recur, but it is not a persisting issue or circumstance
3	Possible	Might happen or recur occasionally
2	Unlikely	Do not expect it to happen or occur but it is possible it may do so
1	Rare	This will probably never happen or occur

Risk Score:

Risk is the likelihood of harm occurring with an indication of how serious that harm could be.

Risk Rating = Likelihood of Occurrence X Consequence of the Incident

Consequence	Probability				
	Rare (1)	Unlikely (2)	Possible (3)	Likely (4)	Almost Certain (5)
Catastrophic (5)	5	10	15	20	25
Major (4)	4	8	12	16	20
Moderate (3)	3	6	9	12	15
Minor (2)	2	4	6	8	10
Negligible (1)	1	2	3	4	5

The Risk scores have been ranked from Nil to Extreme according to the table below.

Risk Rankings
Extreme = >14
High = 10 to 14
Moderate = 5 to 9
Low = 2 to 4
Nil = 0 to 1



10. Appendix C – Risk Strategies

Risks have been assigned a risk strategy to help define the appropriate measures for risk treatment. These are described on the table below.

Risk Strategies	Description/Example	Suitable for...
Avoid	The Risk is avoided by changing the threat in a way to mitigate the risk.	Some political, technical/operational/infrastructure risks. This may include legal or regulatory issues, maintenance issues, and technical upgrades.
Transfer	Some or all of the risk is transferred to another party. This could be to insurance, different level of government, industry, etc...	Items that will impact the community but are in the jurisdiction of another agency. This may include some natural disasters, flooding, or insurable business risks.
Reduce	Action is taken to reduce the likelihood or consequence of a hazard.	Most common response to a risk. Whenever possible/practical an identified risk should be reduced. Actions are taken in accordance with some plan in order to minimise the risk.
Accept	The risk is accepted due to low probability of consequence. Contingency plans may be prepared.	Some risks may need to be accepted by the community due to impractical options for mitigation of risk. A contingency or response plan may be put in place. This may include war, and unpredictable events such as meteor impacts.
Contingency	A plan is developed to respond if the risk is realized.	This includes a wide range of risks and may be done in parallel with another risk response. In most cases an identified risk of significant likelihood or consequence should have a plan in place.