

Annex E

Inuvik Region Hazard Identification Risk Assessment



Table of Contents

Table of Contents.....	2
1 Executive Summary.....	4
1.1 Inuvik Region Risk Matrix.....	6
1.2 Emerging Issues.....	6
1.3 Climate Change	7
2 Hazard Narratives	8
2.1 High	8
2.1.1 Flood	8
2.1.2 Fire/Explosion	10
2.1.3 Weather - Winter Storm	12
2.1.4 Earth Movement – Other	14
2.2 Medium.....	16
2.2.1 Transportation Accidents.....	16
2.2.2 Critical Infrastructure Failure - Energy Crisis.....	20
2.2.3 Snow Load Hazard.....	22
2.2.4 Critical Infrastructure Failure - Water Contamination.....	24
2.2.5 Human Disease	26
2.2.6 Weather - Wind Storm	28
2.2.7 Critical Infrastructure Failure – Other.....	30
2.2.8 Earth Movement - Permafrost Degradation	32
2.3 Low.....	34
2.3.1 Ice Hazard.....	34
2.3.2 Industrial Emergency	36
2.3.3 Weather - Other Extreme	38
2.3.4 Earth Movement - Earthquake/ Tsunami	40
2.3.5 Food and Agricultural Emergency.....	42
2.3.6 Civil Unrest	43
2.3.7 War/ International Incident	44
2.3.8 Falling Debris.....	45

3	Existing GNWT Response Capabilities.....	46
3.1	Emergency Response and Preparedness Organizations.....	46
3.2	Fire	47
3.3	Police.....	48
3.4	Medical and Health Authorities.....	48
3.5	Search and Rescue	49
3.6	Canadian Forces.....	50
4	HIRA Conclusions	51

1 Executive Summary

The 2014 Inuvik Region Hazard Identification Risk Assessment (HIRA) identifies the hazards and examines the risks that pose a threat to the people, property, environment and economy of the Inuvik Region. This type of assessment is a critical part of any emergency management program. Identified hazards can be used in preparedness programs, emergency response plan exercises, and training and awareness programs.

Governments have limited resources and planning for every possible hazard is not a realistic approach. However, an informed ranking of hazards provides a cost-effective approach to hazard mitigation, emergency planning and response. This assessment identified and rated twenty hazards that could affect the Inuvik Region, and then ranked them in order of emergency planning priority. Each region of the Northwest Territories (NWT) has some unique features that were taken into consideration in rating and ranking their hazards.

The Inuvik Region Hazard Summary (insert) provides a list of the hazards ranked into three categories of high, medium and low. These rankings are supported by the Inuvik Region risk matrix (page 6) and the information outlined in the hazard narratives in Section 2, "Hazard Narratives." Each hazard narrative contains risk mitigation strategies to help emergency planners improve their preparedness and response plans. The rankings were determined using best practices methodology combined with insight from communities and local experts and therefore, may not be identical to risks assigned using other methods or criteria.

The Inuvik Region borders the Yukon Territory to the west, Nunavut to the east and the Arctic Ocean to the north. It covers an area of 365,094 square kilometers and has a population of 6712 people (2011 census). The Inuvik Region accounts for about 16% of the NWT's population and about 12% of personal income. Its

Inuvik Region Hazard Summary

High

1. Flood
2. Fire/Explosion
3. Weather - Winter Storm
4. Earth Movement – Other

Medium

5. Transportation Accidents
6. Critical Infrastructure Failure - Energy Crisis
7. Snow Load Hazard
8. Critical Infrastructure Failure - Water Contamination
9. Human Disease
10. Weather - Wind Storm
11. Critical Infrastructure Failure – Other
12. Earth Movement - Permafrost Degradation

Low

13. Ice Hazard
14. Industrial Emergency
15. Weather - Other Extreme
16. Earth Movement - Earthquake/ Tsunami
17. Food and Agricultural Emergency
18. Civil Unrest
19. War/ International Incident
20. Falling Debris

physical features include the Mackenzie Mountains, the Arctic Ocean, and the Delta. The town of Inuvik is the third largest community in the NWT and Inuvik Region's major commercial and administrative centre.

Flood and Fire/Explosion were found to be the highest risk hazards in the Inuvik Region having frequently impacted communities and caused extensive damage to people, property, the environment and the economy. Both the Flood and Fire/Explosion hazards were also found to be very likely to increase in frequency due to climate change and cause more extensive damage to communities in the future.

Flooding has historically been a high hazard in this region in Aklavik, Fort McPherson, Tsiigehtchic and Tuktoyaktuk. The site of the town of Inuvik was chosen because it had a low flood risk.

Two communities in the Inuvik Region have development areas with an extreme wildfire hazard. Urban fires and arson in isolated communities with volunteer firefighters can lead to a loss of critical infrastructure.

The Inuvik Region experiences long winters and access to communities can be frequently hampered by severe winter weather sometimes lasting several days.

Earth movement is recognized as a high hazard across the Inuvik Region. In Tsiigehtchic the riverbank is eroding to the point where buildings and houses are threatened. In Sachs Harbour, Paulatuk and Tuktoyaktuk increased wind and water erosion is affecting the community. In Inuvik, there have been severe landslides in the windy hills area of town and parts of the Dempster Highway have been threatened by recent slides.

1.1 Inuvik Region Risk Matrix

FREQUENCY	Likely	✓ Weather-other extreme	<ul style="list-style-type: none"> ✓ Critical Infrastructure Failure-energy crisis ✓ Critical Infrastructure failure-water contamination 	<ul style="list-style-type: none"> ✓ Flood ✓ Fire/Explosion ✓ Weather-winter storm ✓ Earth movement – other
	Unlikely	✓ Food and agriculture emergency	<ul style="list-style-type: none"> ✓ Human disease ✓ Weather-wind storm ✓ Earth movement-permafrost degradation 	<ul style="list-style-type: none"> ✓ Transportation accident ✓ Snow load hazard ✓ Critical Infrastructure Failure-other
	Rare		<ul style="list-style-type: none"> ✓ Ice hazard ✓ Civil unrest ✓ Falling debris 	<ul style="list-style-type: none"> ✓ Industrial emergency ✓ Earth movement-earthquake & tsunami ✓ War/International incident
		Low	Medium	High
		IMPACT		

1.2 Emerging Issues

Large scale infrastructure projects have inherent risks in their construction. The GNWT is committed to the design, development, construction, and maintenance of a highway extending NWT Highway 8 (the Dempster Highway) from Inuvik to Tuktoyaktuk. The construction and maintenance of a new highway could impact the hazard ranking presented in this document.

The development of the Ikhil Gas Project has been providing the community of Inuvik with access to gas for electrical generation and heating but can no longer provide a long-term natural gas supply. However, the region also has significant gas resources. An application to develop the Mackenzie Gas Project is currently under review. Further development of the oil and gas resources in this region will affect many of the hazards rated in this assessment especially Critical Infrastructure – Energy crisis and Industrial Accidents.

The present level of preparedness for oil spills response is limited. There is an initial near shore spill response capacity for land-based oil-handling facilities during community fuel resupply operations. The Canadian Coast Guard (CCG) has placed community packs of spill equipment in the region. Because of the low frequency of spills, it is difficult to maintain peoples' training levels. It is anticipated that a drilling program might not occur in the Canadian Beaufort Sea until at least 2018. When a drilling program is approved, increased spill response capacity will be required.

Weather and ice conditions are becoming harder to predict in the Inuvik Region, leading to a greater vulnerability to weather and ice hazards in the future. Inexperienced hunters may not be as well equipped to cope with the risks of hunting, and changing climatic conditions may make it even more hazardous for them. This could lead to an increased vulnerability to ice hazards and an increased need for search and rescue response.

1.3 Climate Change

Climate change strongly affects the hazards of the NWT. Temperatures have already increased by 3 to 4 degree Celsius over the past 50 years in the NWT and this rate will continue or increase. Climate change shifts the wind and cloud patterns and changes how many storms and lightning strikes impact the region. Northern climate change has been hard to predict but these are some of the effects that could increase the frequency or impact of hazards in the future:


- Rapidly rising temperatures (Fire/Explosion Hazard, Transportation Accidents Hazard, Critical Infrastructure Hazards, Earth Movement Hazards, Human Disease Hazard);
- Shorter, warmer winters (Transportation Accidents Hazard, Critical Infrastructure Hazards);
- Increased rain and snowfall in many regions (Flood Hazard, Snow Load Hazard, Weather Hazards, Earth Movement Hazards);
- More extreme fall and winter storms (Weather Hazards);
- Less predictable weather (Weather Hazards);
- Increased winds in some areas (Weather Hazards);
- Thinner ice (Ice Hazard);
- Lower water levels in some lakes and rivers (Critical Infrastructure Hazards, Water Contamination Hazard, Transportation Accidents Hazard);
- More forest fires in some areas (Fire/Explosion Hazard); and
- Rising sea levels (Flood Hazard, Earth Movement Hazards).

A more extensive discussion on climate change can be found in the 2014 NWT HIRA Section 8.3 Specific Climate Change Report.

2 Hazard Narratives

2.1 High

2.1.1 Flood

	Definition An overflow or surge of water which causes or threatens loss of life and property and environmental damage	Class Natural Hazard
	NWT greatest impacts to date 1800 Evacuated Estimated Total Cost \$3,500,000	
	Climate Change Projected to increase both frequency and consequence	
	Figure 1: Flooding in Aklavik – June 2013. (Source: GNWT MACA)	
Mitigation Strategies	<ul style="list-style-type: none">✓ Outline a water management and community development policy.✓ Develop and exercise plans/programs for:<ul style="list-style-type: none">○ watershed management;○ river/lake/ocean modeling/prediction and monitoring;○ erosion control; and○ flood response.✓ In the face of rapid snowmelt and intense rains in spring and summer, communities susceptible to flash flooding should review and improve their drainage facilities and protect vulnerable buildings and facilities.	
Vulnerability		
People	Description Evacuation of communities due to flood events is common. Deaths and injury due to flooding can occur during heavy rainstorm events which can interfere with evacuation attempts. Deaths in the NWT due to flooding are rare.	
Infrastructure	Personal property damage can be extensive. Contamination by floodwaters, structural damage, and mold can destroy buildings. Roads can be damaged or washed away. Damage to infrastructure can be extensive. Flooding can also negatively affect utilities and critical infrastructure. Utilities such as wastewater treatment, electricity and gas may be disrupted in the event of a flood. Emergency ground vehicles may be unable to respond if roads and bridges are flooded, washed out or covered by debris.	
Communications	Communication towers can be damaged by flooding events.	

Inuvik Exposure/History

When	Where	Impact
1937	Aklavik	Flooding.
1944	Tuktoyaktuk	Storm Surge 3 m above MSL.

1961	Aklavik	Flooding.
Sept 1970	Tuktoyaktuk	Storm Surge 3 m above MSL.
1982	Aklavik	Spring runoff and ice jams cause flooding and extensive damage. Estimated Total Cost: \$141,412
1992	Aklavik	Flooding.
Sept 22, 1993	Tuktoyaktuk and Mackenzie Delta	A severe storm with winds from the northwest of up to 96 km/h generated a 1.68 m surge and raised water levels to 2.2 m above chart datum. Coincident with approximately 90% open water offshore, waves were relatively powerful and, together with the high water levels, resulted in damage to or destruction of about half the shore protection at Tuktoyaktuk, and flooding in the community and parts of the Mackenzie Delta.
May 27, 2006	Aklavik	A week long evacuation and infrastructure damage when the Peel River Channel overflowed its banks, swamping the town under several feet of water. Evacuated: 300 Estimated Total Cost: \$3,500,000

In the Inuvik Region, communities are effected by two types of flooding, ice jam and storm surge. Rivers break up much earlier than lakes and these bottlenecks can cause ice jams. High spring flows and major ice jams in the Middle Channel of the Mackenzie Delta can cause widespread flooding, affecting the community of Aklavik. As much as 95% of the delta can be covered by water in some years (e.g., 1961, 1982 and 1992). Environment Canada field staff advises and assists the local flood watch committee in Aklavik. During the late summer and fall, Beaufort Sea storm surges cause flooding in Tuktoyaktuk when the pack ice retreats 100 km or more from the shore.


These three Inuvik Region communities are designated flood risk areas:

- Fort McPherson;
- Aklavik; and
- Tuktoyaktuk.

Community Meeting Feedback

In the Inuvik Region, Aklavik has an issue with seasonal flooding. The Aklavik airport is very vulnerable to flood and the community would be cut-off completely without it. According to the residents, Fort McPherson and Tsiigehtchic have been threatened by flooding as well.

2.1.2 Fire/Explosion

 <p>Figure 2: Pictured is the south flank of a forest fire Near Inuvik. At its closest point, the fire was within 12 km of the community, July 5, 2012. (Source: NNSL/ photo courtesy of the Department of Environment and Natural Resources)</p>		Definition Uncontrolled burning and/or a sudden, violent release of gas under pressure which causes or threatens loss of life and property and environmental damage	Class Natural and Human-induced
		NWT greatest impacts to date 950 Evacuated Estimated Total Cost \$12,044,118	
		Climate Change Projected to increase both frequency and consequence	
Mitigation Strategies	<ul style="list-style-type: none">✓ Consider implementing FireSmart programs for the community and include the response capabilities for urban/rural/wildland fires.✓ Create fire education training and awareness sessions for first responders and the public.✓ Enforce fire prevention practices.		
Vulnerability		Description	
People		High injury and fatality potential from the immediate threat of the fire and the blast as well as an increased mortality rate and respiratory symptoms due to smoke.	
Infrastructure		Total loss or damage to most infrastructure including public buildings, roadways, rail-lines, power facilities and water treatment plants. Smoke can impede evacuation of remote communities by air.	
Communications		Any existing power lines can be damaged and destroyed by fire/explosion cutting off communication links. The same holds true for microwave towers in regions without in-place power lines.	

Inuvik Exposure/History

Table 1: Wildfires and Urban Fires with Losses of \$500,000 and Over

Where	When	Impact
Inuvik	1968	Wildfire – Fire guards built around town, 35,120 HA burnt (\$160,000 of timber in 1968\$), communication to CFB cut due to destruction of poles and CFB communications tower, roads closed. Estimated Total Cost: \$54,000 (in labour and equipment)

Where	When	Impact
Fort McPherson	Jan 1996	Urban fire – School. Estimated Total Cost: \$7,000,000
Fort McPherson	April 1998	Urban fire – Hotel. Estimated Total Cost: \$1,200,000
Tsiigehtchic	1999	Wildfire - Town threatened and the highway closed.
Inuvik	Nov 2010	Urban fire – A hangar and three planes, King Air, B99 and Twin Otter.
Inuvik	2012	Urban fire - Lions Club loss of building.
Inuvik	Aug 2013	Urban fire - Building that houses the NWT Housing Corporation offices, Inuvik Gas, and the Inuvialuit Development Corporation offices. Estimated Total Cost: between \$500,000 and \$750,000

Wildfire

Lightning activity over the Mackenzie Basin in the southern part of Inuvik Region is short but intense, with a strong peak in cloud-to-ground lightning during July. The maximum area of lightning activity is influenced by local moisture sources and by topography. Lightning causes up to 80% of the forest fires in the NWT. The following communities in the Inuvik Region have a wildfire FireSmart hazard of high or extreme:

Table 2: FireSmart Hazard Areas of High or Extreme in NWT According to Community CWPP

Community	Development Area	FireSmart Hazard
Fort McPherson	East Cabins	High-Extreme
Inuvik	Shell Lake	Moderate-Extreme
	Airport Lake Remote Cabins	Extreme

In the Southern communities of the Inuvik Region, forests increase the fire load and the risks to the communities.


Explosion

Many communities have large fuel tanks needed to prepare for the winter months. This large fuel load can result in an explosion if an ignition source is introduced.

Community Meeting Feedback

The Inuvik regional workshop supported the ranking of fire as a high hazard. Residents have observed drier summers heightening fire risks. There is also a concern in Fort McPherson that their water supply at Deep Water Lake could be cut off from access by fire, as it has in the past.

2.1.3 Weather - Winter Storm

		Definition Strong weather characterized by ice, snow and freezing rain	Class Natural Hazard
<p>Figure 3: Blizzard conditions in Inuvik caused flight delays and school and office closures – January 2012. (Source: CBC News video)</p>		NWT greatest impacts to date <ul style="list-style-type: none">• Infrastructure damage (power failure, airport damage)• Property damage	
		Climate Change Projected to increase both frequency and consequence	
Mitigation Strategies	<ul style="list-style-type: none">✓ Develop and enforce snow load standards.✓ Ensure that plans are in place for severe winter storms.✓ Develop/distribute and facilitate a public awareness program around how to prepare for and what to do in a severe winter storm.✓ Identify and communicate available “safe areas” for community members.		
Vulnerability		Description	
People		Heavy winds and cold temperatures can combine with power loss to cause injury and death that could be extensive. Blowing snow creates hazardous driving and working conditions (see Transportation Hazard).	
Infrastructure		Heavy winds and snow can cause damage to buildings, loss of power and water and sewage systems. Snow build-up on roofs can cause collapse (see Snow-Load Hazard).	
Communications		Snow and heavy winds can knock out communications systems.	

Inuvik Exposure/History

Winter storms cause millions of dollars of lost revenue due to shut down of operations and slow transportation of goods and services every year. The increased frequency of snowstorms has had an impact on roadway safety. More snow removal is necessary to allow for safe travel, and the transportation of goods.


Recent Blizzard Events

When	Where	Impact
Jan 2005	Tuktoyaktuk	Temperatures dipped below -30°C and winds topped 117 km/h, Some homes lost power for 5 days, and water and sewage services were unavailable. Five houses froze solid, likely with burst pipes and ruined pumps.
March 2011	Inuvik	Winds reached 70 km/h. The blizzard also knocked out the internet, cell-phone service, bank machines, Interac card service and any calls other than local calls for three-and-a-half days.
Jan 17 and 18, 2012	Inuvik	Winds at Inuvik peaked at 100 km/h, while more isolating blizzard conditions endured for over 24 hours. Winds took off several roofs, including one at the Inuvik Airport, and lifted and shifted other items all around the region.

Community Meeting Feedback

There was a general consensus amongst participants at all meetings that while the NWT was experiencing milder winters on the whole, the winter weather was becoming more extreme in terms of storms and temperature variance.

2.1.4 Earth Movement – Other

		Definition Movement of the ground causing wide spread damage not involving permafrost degradation or earthquake	Class Natural Hazard
Figure 4: Coastal Erosion Tuktoyaktuk (Source: NWT Climate Change Impacts and Adaptation Report, 2008))		NWT greatest impacts to date <ul style="list-style-type: none">• Fatalities 1• Property damage \$1,000,000• Infrastructure	
		Climate Change Projected to increase both frequency and consequence	
Mitigation Strategies	<ul style="list-style-type: none">✓ Develop and enforce building standards.✓ Develop/distribute and facilitate public awareness programs.✓ Ensure that emergency plans are in place.✓ Ensure “safe areas” are available and known to community members.		
Vulnerability		Description	
People		Injuries or even death could occur from shoreline collapse or sinkholes.	
Infrastructure		Damage to buildings, roads and other infrastructure has and is being caused by these earth movements including erosion, riverbank collapse and sinkholes. Also increase in maintenance costs associated with landslides and avalanches, even where no infrastructure damage occurs.	
Communications		Interruption can occur if earth movement impacts communication towers. Falling ash from Alaska could impact communication or air travel.	

Inuvik Exposure/History

When	Where	Impact
1950's	Aklavik	Erosion was partially responsible for the relocation of government and businesses from Aklavik (for further information see Flooding Hazard).
1982	Tuktoyaktuk	Caused the relocation of an RCMP detachment, the undermining and destruction of a curling rink and the abandonment of an elementary school, which was dismantled in 1996.

Across the NWT, people have experienced losses from various earth movement hazards.

Coastal erosion has been severe on Territorial northwestern shores, especially near Tuktoyaktuk. This is due to sea level rise, increased storm activity, less protective shore ice, land subsidence and permafrost thaw. Erosion has been a long term problem in Tuktoyaktuk.

In Tsiigehtchic, riverbank erosion is threatening two churches and a cemetery. If either church is occupied when further earth movement occurs, there is a high risk of property damage, injury or even loss of life.

Landslides also pose a threat in the region. In the Mackenzie Valley, there is an average of one landslide per 5 km, the dominant landslide types are retrogressive thaw flows (28%) and active layer detachments (26%) and about 47% of all landslides took place in moraine deposits.

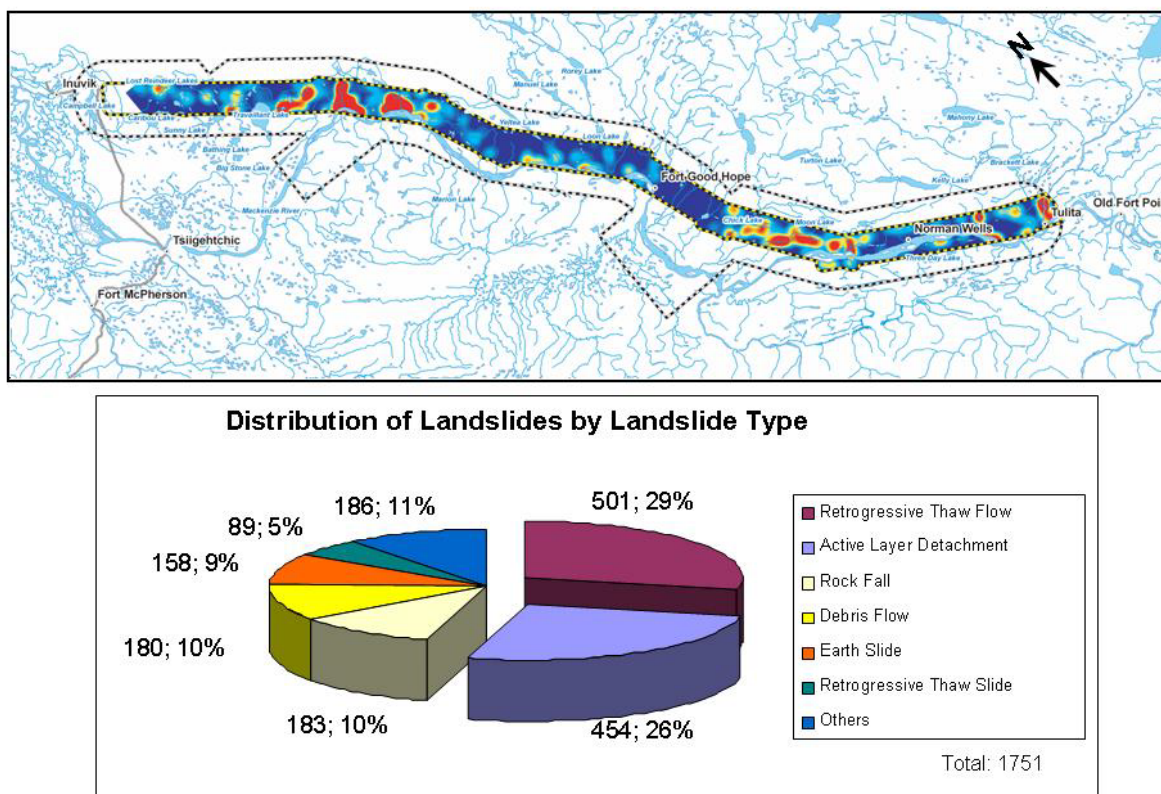


Figure 5: Upper figure—Landslide density map along the proposed pipeline corridor with some “hot spots” of higher density of landslides. These are situated near Travailant Lake, Thunder River, Between Fort Good Hope and Norman Wells, and in the vicinity of Tulita.


Lower figure: Distribution of landslide types in the study area. (Source: Couture et al., 2007)

Community Meeting Feedback

Earth movement is recognized as a high hazard across the Inuvik Region. Resident of Tsiigehtchic confirmed the riverbank is eroding to the point where buildings and houses will soon be threatened. In Sachs Harbour increased wind and water erosion is affecting the community. In Paulatuk, severe winds and heavier snow loads are causing increased erosion issues within the community. In Tuktoyaktuk, there is an increase in wind and water erosion. In Inuvik, there have been severe landslides in the windy hills area of town and parts of the Dempster Highway have been threatened by recent slides.

2.2 Medium

2.2.1 Transportation Accidents

		Definition All vehicle accidents which involve large loss of life and property damage	Class Human-induced Hazard
<p>Figure 6: A truck which was doing work on the ice road near Inuvik, N.W.T., broke through the ice. Seen here, it is surrounded by water which surged above which surged above the ice through the hole the truck made. (Source: CBC News/photo Facebook)</p>		NWT greatest impacts to date <ul style="list-style-type: none">Fatalities 32Infrastructure damage (power failure, airport damage)Property damage	
		Climate Change Projected to increase both frequency and consequence	
Mitigation Strategies	<ul style="list-style-type: none">✓ Enforce safety and prevention programs.✓ Ensure Dangerous Goods practices/regulations are followed.✓ Implement transportation route monitoring programs.✓ Confirm that emergency response plans in place for all areas to allow for prompt response to transportation accidents.		
Vulnerability		Description	
People		Accidents, specifically motor vehicle accidents, are one of the highest causes of death and injury to Canadians every year. Amongst young Canadians (below age 25) vehicular accidents are the number one cause of death in the country. Largest loss of life in one accident usually occurs on passenger flight accidents.	
Infrastructure		Any accident which occurs on a roadway has the ability to damage the roadway and therefore leave already isolated areas without any road access. The same holds true for aircraft accidents which may close down an airport making it virtually impossible to gain access to several communities in the NWT.	
Communications		Given that communication hubs are serviced by a single communication line, especially in the southern NWT, any accident may cut these lines leading to loss of communications.	

Inuvik Exposure/History

When	Where	Impact
Feb 20, 2007	Parry Peninsula	A hunter went adrift on an Arctic ice floe when winds caused his land tether to break. A Canadian Forces helicopter search and rescue team made a daring jump onto the ice floe and stayed with the stranded hunter overnight. It was below -50°C with the wind chill.

When	Where	Impact
July 24, 2008	North of Inuvik	Members of three generations of an Inuvik family, on their way to take part in a traditional beluga whale harvest, perished after their six-metre boat capsized in the Mackenzie River. Fatalities: 4
Sept 9, 2013	McClure Strait north of Banks Island on the opposite side of the island from Sachs Harbour	Helicopter operating with the Canadian Coast Guard research icebreaker Amundsen crashed into the Arctic Ocean. Fatalities: 3

Accidents in the Inuvik Region are more likely to end in injury or death than those of North and South Slave Regions as they do not have separate Highway Rescue units. The Inuvik regional transportation infrastructure includes gravel and ice roads, ports and airports. The town of Inuvik is the major transportation hub in the region. The Dempster Highway provides an all-weather link with the Yukon. The Dempster Highway connection is currently limited to communities south of Inuvik. A network of winter roads connects Aklavik and Tuktoyaktuk to Inuvik.

Winter access roads are open in winter, usually from about mid-December to late April, but may vary with weather conditions and locations. Some of them are privately operated and maintained, and offer no services, emergency or otherwise. Unleaded gas, diesel and propane are available in most communities on the highway system, with repair facilities in larger towns. Distances between these services may be significant, however, and hours of operation limited.

Marine Accident

There is also a well-developed marine freight route along the Mackenzie River to the Arctic Ocean. Navigation problems on the Mackenzie River include: a short shipping season (beginning of June to mid-October), ice conditions, low water levels (especially in the fall), four sets of rapids and decreasing daylight in the fall.

Aircraft Accident

The town of Inuvik has daily flights linking the community and region to Yellowknife. Communities such as Paulatuk and Sachs Harbour are accessible only via air. Statistically, approximately 30% of aviation accidents are weather related and up to 75% of delays are due to weather. The Inuvik Region experiences a number of aviation weather hazards including: icing, poor visibility, wind shear and turbulence, weather fronts and thunderstorms. Aging infrastructure at some airports increases the community hazard exposure.

Table 3: Inuvik Region Transportation Risk Exposure


Community	Air	Road	Water/Rail
Aklavik	By air from Inuvik year round on Aklak Air, which has five scheduled flights per week.	Winter ice road connects to the Dempster Highway through Inuvik.	Bulk supplies and food are barged in during the summer months.
Fort McPherson	Located 3.2 km south of the hamlet, the airport was built in 1972 and has a gravel runway (3500' x 100') and an air terminal building. There is limited, seasonal service.	Accessible by the Dempster Highway from Dawson City, Whitehorse and Inuvik year round. There are minor disruptions to road access with during break-up and freeze-up.	"Abraham Francis" Ferry service Km 74 – Peel River This crossing is subject to extreme high and low water level fluctuations which may cause delays at any time.
Inuvik	Twelve kilometres east of the community, the full-service airport was built in 1956/58. It has an asphalt runway (6000' x 150') and an air terminal building. A number of scheduled and charter flights operate daily. Inuvik Mike Zubko Airport is deemed a port of entry into Canada and is staffed by the Canada Border Services Agency.	The Dempster Highway begins just outside Dawson City, Yukon and stretches 730 kilometres to Inuvik. It is an unpaved, gravel road. There are two ferry crossings that make the road impassable for periods during break-up and freeze-up. In the winter drivers cross the rivers by ice bridge.	
Paulatuk	Adjacent to the hamlet and built in 1994, the airport has a gravel runway (4000' x 100') and an air terminal building. A scheduled air service operates three times a week.		
Sachs Harbour	The airport is adjacent to the hamlet and was built in 1955/56. It has a gravel runway (4000' x 100') and an air terminal building. A scheduled air service operates twice weekly.		
Tsiigehtchic		Accessible from the Dempster Highway	"Louis Cardinal" Ferry services are

Community	Air	Road	Water/Rail
		either from the Yukon or from Inuvik. The highway from Inuvik crosses the river using a ferry service in summer (from 0900-0100, late May-late October) and ice road in winter.	provided at Mackenzie River Hwy 8
Tuktoyaktuk	The airport was built in 1955 and lies 3.2 km SE of the hamlet. It has a gravel runway (5000' x 150') and an air terminal building. Scheduled flights to Inuvik operate daily. Tuktoyaktuk James Gruben Airport is deemed a port of entry into Canada.	In the winter an ice road is built along the waterways of the Beaufort Delta between Inuvik and Tuktoyaktuk.	
Ulukhaktok	Built in 1978, the airport lies 3 km north of the hamlet and has a gravel runway (4300' x 100') and an air terminal building. Scheduled flights operate two days each week.		

Community Meeting Feedback

In Sachs Harbour, the road from the airport to the community runs very near the fuel tank farm and there have been near misses where vehicles have almost collided with the tanks.

2.2.2 Critical Infrastructure Failure - Energy Crisis

		Definition Failure to provide energy required to meet basic human needs, sustain the economy, and protect public safety and security	Class Human-induced Hazard
<p>Figure 7: Wells at the Ikhlil deposit 18 miles from Inuvik have supplied the Arctic town with natural gas since 1999. But one well has watered in and the other is almost tapped out, causing an energy crisis for Inuvik. (Source: National Energy Board, Government of Canada)</p>		NWT greatest impacts to date Declared state of emergency	
		Climate Change Projected to increase both frequency and consequence	
Mitigation Strategies	<ul style="list-style-type: none">✓ Understand the potential risks associated with Critical Infrastructure Failure – Energy Crisis.✓ Build partnerships between stakeholders.✓ Ensure back up/alternate systems in place for life safety.✓ Ensure emergency response plans in place.		
Vulnerability		Description	
People		Given the severe weather in the north; the population relies on a steady and safe supply of energy to provide heating in the winter. Most areas of the NWT are extremely isolated and the health hazards of being left without energy/power are both physical and mental.	
Infrastructure		Water lines and sewage lines can freeze and break in severe winter weather without heat or flowing water. Loss of power can cause a situation where pipes burst in the colder temperatures.	
Communications		Loss of electrical power can cause disruption to communication systems such as radio and television which people rely on for information.	

Inuvik Exposure/History

In the Inuvik Region, there are two main energy sources used to generate electricity, natural gas and diesel fuel.

Since 1999, residents and businesses in the Town of Inuvik have had their energy needs supplied by two natural gas wells at the Ikhlil site. In November 2010, one of the two wells had an unexpected inflow of water, resulting in the well no longer being able to produce natural gas. Efforts to repair the well (K-35) were unsuccessful. It is no longer in operation. The second well (J-35) currently provides part of the town's energy supply, although an independent reserve report confirmed that the recoverable reserves are significantly less than previously estimated. As a result, Ikhlil can no longer provide a long-term natural gas supply. As an interim measure, the town of Inuvik is using a mix of propane and air, referred to as synthetic natural gas (SNG), which is now being injected into the gas distribution system for customers.

In November of 2013, the town of Inuvik was cut off from new shipments of propane because the ferry was not operating and ice roads had not opened yet. The town was able to switch from propane to natural gas from the Ikhlil Natural Gas Facility to deal with the emergency but this option will not be available in the future.

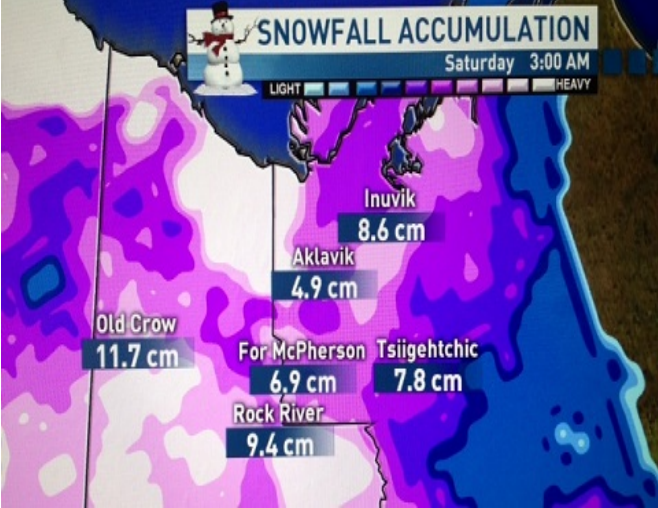
Most of the communities in the Inuvik Region have electricity provided by diesel-fired power plants. Alternative Energy Programs are being put in place such as wind turbines in Sachs Harbour. Fuel must be shipped into the communities by road, pipeline, barge, road or air. A shortened ice road season, Dempster highway, barge or pipeline disruption, or prolonged extreme weather events can lead to shortages of fuel in communities.

Community	Power Source (NWT Power Corporation website)
Aklavik	Plant currently has a 1.28 MW capacity consisting of four 320 kW diesel engines.
Fort McPherson	Total installed capacity of the plant is 1.83 MW. The plant also provides residual heat to various buildings using the Aadrii heating system.
Inuvik	Thermal Operations Regional Office Complex is located in Inuvik. Two power plants consist of: <ul style="list-style-type: none"> • three natural gas fuelled generators rated at 2.8 MW, 2.8 MW, and 2.1 MW; • two 2.5 MW diesel generators; • one 720 kW diesel generator; and • one 300 kW diesel generator.
Paulatuk	Power plant has a total installed capacity of 840 kW.
Sachs Harbour	Three diesel generators with a total installed capacity of 795 kW.
Tsiigehtchic	Three small generating units with a total capacity of 500 kW.
Tuktoyaktuk	Three diesel generators have a total installed capacity 2.21 MW.
Ulukhaktok	Three diesel generators that have a combined capacity of 1.16 MW. The plant also has a small heat recovery system that heats three buildings in the community.

Community Meeting Feedback

The residents of Inuvik confirmed there have been severe shortages of natural gas in recent years to the point where the community is looking at alternate means of powering facilities. They also mentioned that the local pipeline is in disrepair and if one valve were to fail the entire pipeline would have be shut down.

2.2.3 Snow Load Hazard

 <p>Figure 8: •A low pressure system moving through the Beaufort is bringing steady snow for the Mackenzie Delta, February 6, 2014. (Source: CBC News/Christy Climenhaga)</p>	<p>Definition</p> <p>Potential collapse of buildings due to the weight of build-up or drifting of snow</p>	<p>Class</p> <p>Natural Class</p>
<p>Mitigation Strategies</p> <ul style="list-style-type: none"> ✓ Include snow load hazards in community response plans. ✓ Clear snow from public building rooftops. ✓ Perform a Roof Risk Assessment on key community structures such as schools and community centers. 	<p>NWT greatest impacts to date</p> <p>Property Damage (Roofs)</p>	
	<p>Climate Change</p> <p>Projected to increase both frequency and consequence</p> <p>Structures are built using historical snow load standards. When the snow load exceeds the standards, due to wetter, heavier, more frequent or drifting snow, structures can collapse.</p>	
<p>Vulnerability</p>	<p>Description</p>	
<p>People</p>	<p>High numbers of injuries or deaths could occur if an occupied community building or school were to collapse.</p>	
<p>Infrastructure</p>	<p>Loss of the building and contents plus loss of the use of this building until repairs or a new structure can occur.</p>	
<p>Communications</p>	<p>Potential collapse of microwave towers due to snow load could impact the community's communications.</p>	

Inuvik Exposure/History

When	Where	Impact
May 5, 2004	Inuvik	Samuel Hearne Secondary School roof of the foyer collapsed caused by a record-breaking build-up of snow. Due to the timing of the event, no one was hurt in the collapse.

Community Snow Load Risk Factors

Community	Community Snow Load Risk Factor
Aklavik	Moderate
Fort McPherson	Moderate
Inuvik	Moderate
Paulatuk	Low
Sachs Harbour	Low
Tsiigehtchic	Moderate


Tuktoyaktuk	Low
Ulukhaktok	Low

Studies show that approximately one fifth of public buildings (22%) in the NWT are at risk of collapse due to changing/increasing snow loads. Public buildings at risk include schools, hospitals, community centers and medical centres. Of those buildings at risk, about 10% have been retrofitted since 2004, and another 12% are under a snow load watch status.

Community Meeting Feedback

In Sachs Harbour, the residents agree that this hazard was low for their community as the snow load varies from year to year and there has been no appreciable change in recent years.

2.2.4 Critical Infrastructure Failure - Water Contamination

 <p>Figure 9: Aklavik water supply system Class II water treatment system (Source: GNWT, MACA)</p>		Definition Serious contamination of drinking water or loss of supply, that presents a danger to the general health of the public	Class Human-induced Hazard
		NWT greatest impacts to date Boil water advisories	
		Climate Change Projected to increase both frequency and consequence	
Mitigation Strategies	<ul style="list-style-type: none">✓ Understand the potential risks associated with Critical Infrastructure Failure – Water Contamination.✓ Plan for identification and reduction of contaminants into ground and surface water.✓ Ensure water sampling and monitoring program in place.✓ Ensure emergency response plans are in place.		
Vulnerability		Description	
People		The levels of contaminants in drinking water are seldom high enough to cause acute (immediate) health effects. Examples of acute health effects are nausea, lung irritation, skin rash, vomiting, dizziness, and even death.	
Infrastructure		Disasters that destroy infrastructure may result in water contamination by sewage. Chloride ions, usually found in seawater or acid rain, increase the conductivity of water and accelerate corrosion. Chloride can penetrate and deteriorate concrete on bridge decking and parking garage structures, and damage reinforcing rods, compromising structural integrity. It damages vehicle parts such as brake linings, frames, bumpers, and other areas of body corrosion. It impacts railroad crossing warning equipment and power line utilities by conducting electrical current leaks across the insulator that may lead to loss of current, shorting of transmission lines, and wooden pole fires.	
Communications		Chloride ions from acid rain significantly aggravate the conditions for pitting corrosion of most metals by enhancing the formation and growth of the pits through a process which weakens them over time.	

Inuvik Exposure/History

The responsibility for ensuring safe drinking water is vested with the Government of the NWT, which has passed specific public health legislation designed to ensure the safety of drinking water supplies. The Department of Health is the regulator and is responsible for enforcing the *Public Health Act*, *Water Supply System Regulations*, and *General Sanitation Regulations* as well as ensuring the *Guidelines for Canadian Drinking Water Quality* are met.

Community governments have the authority and responsibility to provide safe potable water to their residents. In communities where the community government is the owner and operator of the water treatment facilities, the community government is responsible for the treatment and safety of the water supply in those operations. Responsibilities include treatment of water to meet the Guidelines for Canadian Drinking Water Quality, the submitting of water samples to a laboratory for bacteriological and chemical analysis, and maintaining records of raw water quality, finished water quality and the amounts of chemicals used in treatment.

When	Where	Impact
2007	Paulatuk	Boil water advisory due to positive bacteriological sample.
July 2008 to March 2009	Sachs Harbour	The community spent more than eight months under a boil water advisory after chlorination pumps failed at the local water treatment plant.
June to Nov 2011	Sachs Harbour	Boil water advisory for five months due to problems with the hamlet's water treatment plant. No related illnesses were reported.
July 13, 2012	Inuvik	Boil water advisory. There were no illnesses associated with drinking water reported.

Community	Public Water Source	Water treatment system classification
Aklavik	Mackenzie River	Class II
Fort McPherson	Deep Water Lake	Class II
Inuvik	Mackenzie River and 3 Mile Lake	Class I
Paulatuk	New Water Lake	Small System
Sachs Harbour	DOT Lake	Small System
Tsiigehtchic	Tso Lake	Class I
Tuktoyaktuk	Kudlak Lake	Class I
Ulukhaktok	RCAF Lake	Small System

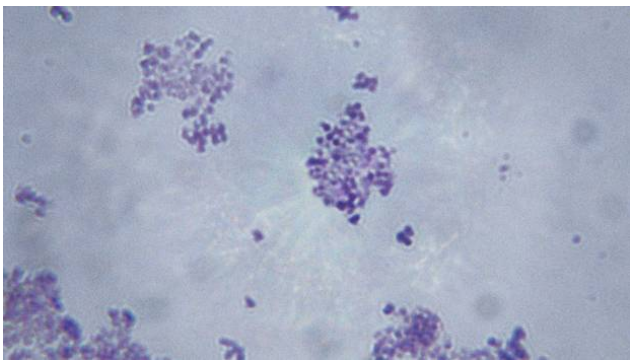
Community Meeting Feedback

The issue of water contamination and the need for clean sources of water was brought up at all community meetings, save those held in Yellowknife.

Residents of the Inuvik Region spoke of the isolated nature of their water supply and the need for an improvement to the local infrastructure in order to ensure a safe supply of water.

Fort McPherson residents reported that the community water supply is located along the highway and if there were to be an accident it could affect the water supply at Deep Water Lake. In Sachs Harbor, the community water supply is located near the airstrip and would be at risk in the case of an accident.

2.2.5 Human Disease

	Definition A grave or widespread illness that presents a danger to people's health	Class Natural Hazard
	NWT greatest impacts to date Fatalities 600	
	Climate Change Projected to increase both frequency and consequence	
Mitigation Strategies	<ul style="list-style-type: none"> ✓ Ensure disease monitoring plans are in place between all levels of government and private sector. ✓ Ensure preparedness plans are in place. ✓ Ensure response plans are in place and are exercised, including containment and quarantine procedures. ✓ Human vaccination against anthrax is available for personnel likely to be involved in investigating or responding to anthrax outbreaks. 	
Vulnerability		Description
People	Injury and death from human disease can severely impact an isolated community where continual medical care is limited.	
Infrastructure	While human diseases do not impact infrastructure directly, some disruption in critical services could occur when enough of the population is affected. Support services to remote communities could be cut off during a pandemic or severe epidemic.	
Communications	N/A	

Inuvik Exposure/History

When	Where	Impact
Between 1890 and 1910	Tuktoyaktuk	Between 1890 and 1910 the population was destroyed by influenza.
1928	Mackenzie District	Influenza epidemic sweeps through the Mackenzie District, killing about 600 people. Approximately 10 to 15% of the population of each village.
Since 2008	NWT wide	Methicillin-Resistant Staphylococcus Aureus (MRSA) infections. 55 hospitalizations (5 of them had to be flown south for treatment). Fatalities: 2
November 2009	NWT wide	H1N1 - 45 hospitalizations. Fatalities: 1

Community	Health Care Facilities
Aklavik	Health and Social Services Centre
Fort McPherson	Health Centre
Inuvik	Inuvik Regional Hospital (includes the Long Term Care Centre)
Paulatuk	Health and Social Services Centre
Sachs Harbour	Health Centre
Tsiigehtchic	Health Centre (Out of Inuvik)
Tuktoyaktuk	Health Centre
Ulukhaktok	Health and Social Services Centre


Pandemic

Worst case scenario in the GNWT Pandemic plan – each community may be completely isolated and little or no extra resources (human or material) will be available from the Region, Territory, or Nation during the Pandemic period.

Community Meeting Feedback

There is a concern in Paulatuk that stale water in the community will eventually lead to an increase in disease.

2.2.6 Weather - Wind Storm

		Definition Strong weather characterized by damaging movement of air	Class Natural Hazard
<p>Figure 11: Parts of the Inuvik, N.W.T., airport seem to have been torn off during the high winds and snow in the region Tuesday – January 2012. (Source: CBC News/Submitted photo)</p>		NWT greatest impacts to date <ul style="list-style-type: none">• Property Damage (drill rig)• Infrastructure (transmission tower)	
		Climate Change Projected to increase both frequency and consequence	
Mitigation Strategies	<ul style="list-style-type: none">✓ Develop and enforce building standards for severe winds.✓ Develop/distribute and facilitate public awareness programs.✓ Ensure emergency plans include response to wind storms.✓ Ensure “safe areas” are available and known to community members.		
Vulnerability	Description		
People	All wind storms have the potential to cause injury or death due to structural damage, flying debris or storm surges. Hurricanes also can cause flooding (see Flood hazard). Tornadoes can cause many injuries and death but are very rare across the NWT.		
Infrastructure	Heavy winds can cause great damage to buildings and infrastructure, and knock out power across large areas. Tornadoes can cause heavy damages but are very rare across the NWT.		
Communications	Heavy winds are often responsible for damage to communications towers.		

Inuvik Exposure/History

When	Where	Impact
1985	Beaufort Sea	An Oil rig on the Minuk I-53 sacrificial beach island was lost during a severe storm in the Beaufort Sea. The drill rig, modules, camp and ancillary equipment were destroyed.
Aug 2012	Beaufort Sea	A very strong cyclone developed over eastern Siberia and strengthened rapidly over the central Arctic Ocean north of Alaska. It reached near-hurricane wind speeds and, at its peak on August 6, covered two-thirds of the Arctic Ocean. The storm brought warm winds and in the end was likely responsible for a very rapid loss of ice in the western Arctic. On three consecutive days, sea ice extent dropped by nearly 200,000 square km per day.




On July 19, 2012 at 9:30 p.m. photographic evidence from a cell phone was taken of a funnel cloud near the Inuvik Airport. This was one of the most northern sightings of a funnel cloud anywhere in the world. It did not touch down.

Community Meeting Feedback

Aklavik is seeing stronger winds. In Sachs Harbour, severe weather dramatically affects the community with winds commonly up to 100 km/hr. This often closes the airport and further isolates the community. In Paulatuk, severe winds are causing heightened erosion issues within the community. In Uluhaktok, there has been an increase in blowing dust due to less snow and drier summers.

Figure 12: A funnel cloud was seen near Inuvik July 15. The photo has been circulating on social media sites such as Facebook and Twitter. (Source: NNSL/ photo courtesy of Rebecca Pokiak)

2.2.7 Critical Infrastructure Failure – Other

		Definition Failure of services that meet basic human needs, sustain the economy, and protect public safety and security	Class Human-induced Hazard
<p>Figure 13: Telesat Canada satellite customers like Northwestel lost contact with Telesat's Anik F2 satellite at around 6:00 a.m. Oct. 6, producing a day of chaos across northern Canada – October 2011. (Source: Nunatsiq News/photo by Jim Bell)</p>		NWT greatest impacts to date <ul style="list-style-type: none">• Communications failure• Road Damages	
		Climate Change Projected to increase both frequency and consequence	
Mitigation Strategies		<ul style="list-style-type: none">✓ Understand the potential risks associated with Critical Infrastructure Failure – Other.✓ Build partnerships between stakeholders.✓ Ensure back up/alternate systems in place for life safety.✓ Ensure emergency response plans are in place.	
Vulnerability	Description		
People	People in the NWT rely on infrastructure to keep them supplied and in touch with other communities. Any infrastructure collapse could be catastrophic given the harsh nature of most areas where people live.		
Infrastructure	Airports are subject to closure regularly in the winter, ice roads rely on a consistent pattern of cold weather and all weather roads are also subject to closure during winter season. Any infrastructure collapse is also exacerbated by the fact that the isolated nature of these communities makes it extremely difficult to repair failed infrastructure. Given the isolated nature of most of the communities within the NWT, any incident which closes down an airport could be severe.		
Communications	Communications break downs are common throughout the north as severe weather can shut down facilities and “power bumps” often hamper effective communications. Again, given the isolated nature of the area, repair of these systems is often extremely difficult.		


Inuvik Exposure/History

When	Where	Impact
Oct 6, 2011	10 communities	Telesat's Anik F2 satellite suddenly ceased operating. Remote northern locations were the most affected, with 10 of 33 NWT communities served by Northwestel seeing disruptions from the outage. First Air airline cancelled 48 flights, stranding about 1,000 passengers just before the Thanksgiving weekend.

Community Meeting Feedback

Fort McPherson relies on the air strip for all commodities once the ferry goes out and the winter road is yet to be opened. Without the air strip they are completely cut-off. The Fort McPherson sewage lagoon is surrounded by a berm and the berm is starting to show signs of failure.

2.2.8 Earth Movement - Permafrost Degradation

		Definition Movement of the ground causing wide spread damage caused by loss of permafrost	Class Natural Hazard
<p>Figure 14: An aerial photo shows a massive, 1-km wide permafrost “slump” on the Peel River system. (Source: Northern Journal/ photo NWT Geoscience Office)</p>		NWT greatest impacts to date <ul style="list-style-type: none">• Power failures• Road Damages	
		Climate Change Projected to increase both frequency and consequence	
Mitigation Strategies	<ul style="list-style-type: none">✓ Develop and enforce building standards for building slumping and/or collapse.✓ Develop/distribute and facilitate public awareness programs.✓ Include permafrost degradation risk actions in emergency plans.		
Vulnerability		Description	
People		Injury and death could result from the unexpected collapse of land or a building.	
Infrastructure		Permafrost has always figured heavily into Arctic infrastructure design, construction, and maintenance. Infrastructure systems in permafrost have depended on the stability of permafrost as a foundation material. Permafrost erosion along streams and rivers is threatening dikes, bridges and culverts.	
Communications		Some damage to communication towers possible.	

Inuvik Exposure/History

Ground movement caused by melting permafrost has resulted in the cracking or sloping of building walls and foundations. It has also resulted in heaving, slope failure, sinkholes and potholes, affecting all forms of infrastructure. Permafrost erosion along streams and rivers is threatening dikes, bridges and culverts. Slope failures, in communities such as Sachs Harbour, are becoming unmistakable.

A mixture of different types of permafrost is found under all of the NWT including: continuous, extensive discontinuous and sporadic discontinuous permafrost. The town of Inuvik, because of its size and location, has been identified as particularly vulnerable. 40-75% of the existing buildings in the town are likely to incur foundation damage during the buildings’ lifetime due to permafrost melting. The Factor of Safety (actual or design strength / required strength or loaded stress) has dropped from 1.5 to 1.0 in Inuvik since ground temperatures started increasing.

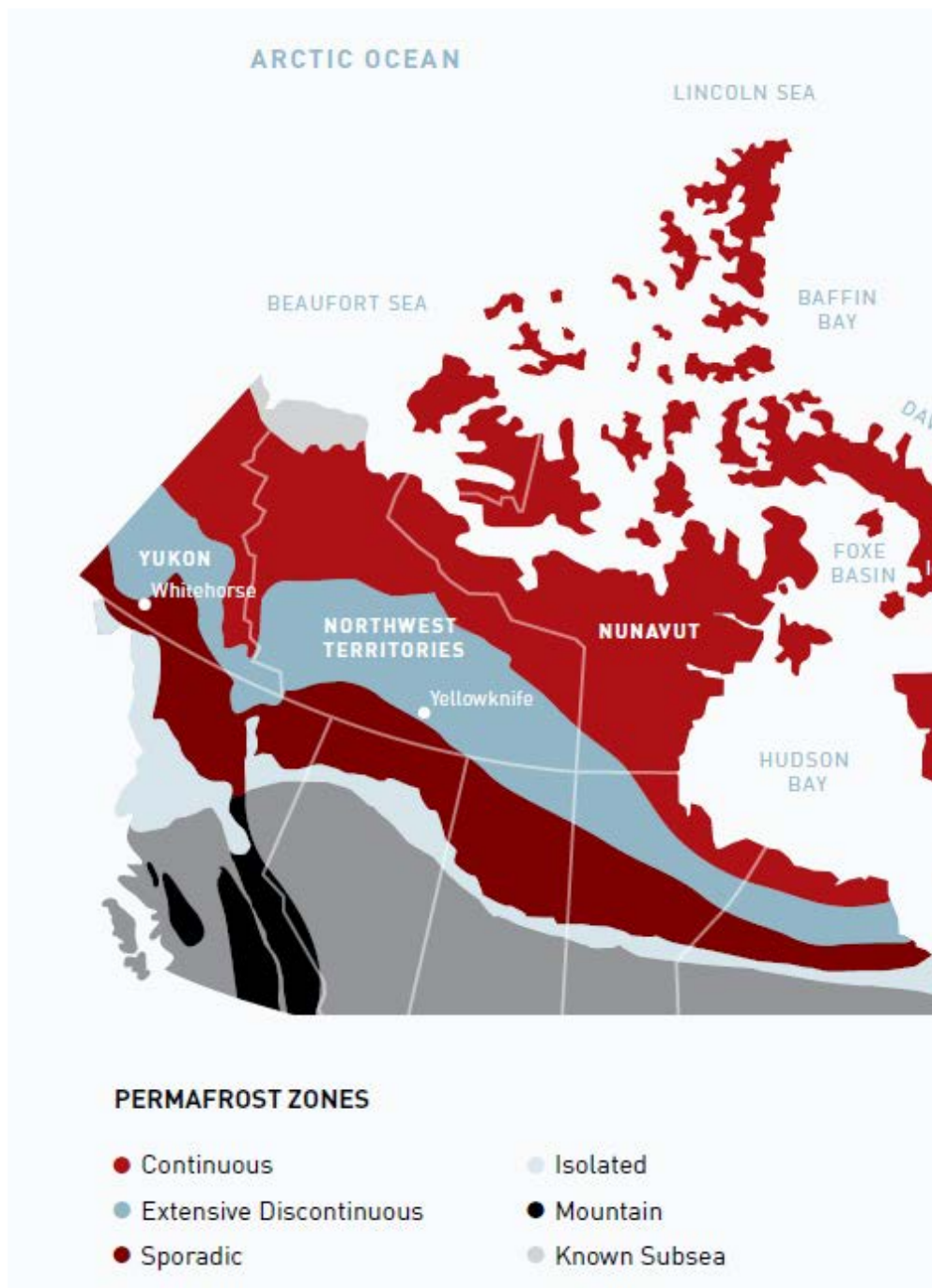



Figure 15: Permafrost Zones (Source: Atlas of Canada Permafrost Map)

Community Meeting Feedback

The issue of permafrost degradation was brought up in all meetings held. Buildings on the permafrost are starting to shift and this is causing problems. A recently built Paulatuk community school sank 8 inches in 2012.

2.3 Low

2.3.1 Ice Hazard

	Definition Formations or movements of ice which cause loss of life, property and/or environmental damage	Class Natural Hazard
Figure 16: The Louis Cardinal ferry operating near Tsiigehtchic – December 2013. (Source: CBC News/photo NWT Dept. of Transportation)	NWT greatest impacts to date <ul style="list-style-type: none"> • Property Damage 	
Mitigation Strategies <ul style="list-style-type: none"> ✓ Develop and enforce building standards for ice accumulations. ✓ Develop/distribute and facilitate public awareness programs. ✓ Confirm that ice storm emergency plans in place. ✓ Ensure “safe areas” are available and known to community members. 		Climate Change Projected to decline
Vulnerability	Description	
People	Injury and loss of life can occur when oil rigs, boats or ships are damaged or sunk by ice (see Transportation Hazards).	
Infrastructure	Icebergs still threaten offshore oil rigs, fishing boats and ships. Ice shoves can damage buildings that are near to a body of water. Seabed gouging or strudel scour can damage off shore oil rigs or pipelines (see Industrial Hazards).	
Communications	None	

Inuvik Exposure/History

When	Where	Impact
Feb 20, 2007	Parry Peninsula	A hunter went adrift on an Arctic ice floe when winds caused his land tether to break. A Canadian Forces helicopter search and rescue team made a daring jump onto the ice floe and stayed with the stranded hunter overnight. It was below -50°C with the wind chill.


Elders and hunters have developed a detailed understanding of the ocean and weather conditions that may cause sudden changes in ice conditions, and generally try to avoid unnecessary risks when traveling on the sea ice. The sea ice can be dangerous to navigate because it is constantly shifting and can be a hazard to offshore structures. It can be either fast ice, which stays close to shore, or drift ice, which moves around and grinds together with great force to form ridges.

Icebergs can represent a serious threat to shipping, because they are difficult to see and avoid. Historically, numerous ships were lost due to iceberg collisions. In the modern era, ships avoid bergs by taking advantage of tracking data about especially large icebergs, along with utilizing technology, which can be used to identify upcoming bergs in the path of a ship.

Community Meeting Feedback

This hazard was not mentioned as a concern at the Inuvik Region meeting.

2.3.2 Industrial Emergency

		Definition Emergencies involving businesses that handle dangerous goods, hazardous wastes or chemicals or engage in potentially hazardous activities	Class Human-induced Hazard
<p>Figure 17: Photo: From left, Premier Bob McLeod, NTPC CEO Emanuel DaRosa and Minister Michael Miltenberger cut the ribbon, officially opening the LNG plant in Inuvik – January 2014. (Source: Northern Journal/photo James Tolley)</p>		NWT greatest impacts to date Environmental Damage	
Mitigation Strategies		Climate Change Projected to increase both frequency and consequence	
<ul style="list-style-type: none">✓ Identify the industries in each community and rank according to risk.✓ Ensure back-ups are in place for the industries ranked as critical.✓ Ensure appropriate safety and emergency plans are in place.			
Vulnerability	Description		
People	Industrial accidents have an enormous impact on the health of workers and on the economy in general, which is reflected in the death, disability and personal suffering of workers on one hand, and in absence from work, loss of productivity and health costs on the other.		
Infrastructure	Industrial accidents can have a dramatic negative affect on physical and virtual systems which are considered critical. This would include fires or explosions, oil spills which could impact water treatment and dam failure which could impact power supply.		
Communications	Communications hubs in small communities could be damaged by an industrial accident in the community.		

Inuvik Exposure/History

Oil and gas industries are the most common hazardous industries in the Inuvik Region. Common causes of fatal injury include: fires, explosions, mobile equipment accidents, falls from height, entrapment and electrocution.


When	Where	Impact
April 06, 1975	High Arctic Islands	Pan-Arctic Oils, Drake D-73 Well Site - 22,817 Gallons Jet/Turbine Oil.
Sept 18, 1985	Beaufort Sea	Esso, Rig #7, W. of Pelly Island - 103,000 Gallons Diesel Fuel/ Heating Oil.

Community Meeting Feedback

Residents of the Inuvik Region spoke of their concern over what has been stored, buried or left in dumps of the region by industries.

The increased shipping traffic through the Northwest Passage, near Sachs Harbour north of Banks Island, has community members concerned about what is being transported through the area.

2.3.3 Weather - Other Extreme

		Definition All weather related hazards excluding wind storm and cold weather storms	Class Natural Hazard
<p>Figure 18: A large bolt of lightning strikes some homes in Inuvik, N.W.T., on Sunday, July 8, 2012. The lightning took out power to some homes and caused problems for radio and television. (Source: CBC News/Philippe Morin)</p>		NWT greatest impacts to date <ul style="list-style-type: none">• Power failures• Road Damages	
		Climate Change Projected to increase both frequency and consequence	
Mitigation Strategies		<ul style="list-style-type: none">✓ Develop and enforce building standards for identified extreme weather hazards.✓ Develop/distribute and facilitate public awareness programs.✓ Ensure that emergency plans are in place.✓ Ensure “safe areas” are available and known to community members.	
Vulnerability	Description		
People	<p>Extreme cold temperatures can cause injury and death. Temperatures of -55 and colder have an extremely high risk of causing injury as exposed skin can freeze in less than 2 minutes. Temperatures of -48 to -54 have a very high risk of causing injury as exposed skin can freeze in 2 to 5 minutes. Temperatures -40 to -47 have a high risk of causing injury as exposed skin can freeze in 5 to 10 minutes.</p> <p>Under foggy conditions, visibility is reduced to less than 1 kilometre and vehicle accidents can result (see Transportation Accidents Hazard).</p> <p>Ocean and lakes areas, and in particular the large lakes such as Great Bear Lake and Great Slave Lake, are cloud and fog prone through the fall until they freeze over completely (see Transportation Accidents Hazard).</p>		
Infrastructure	<p>Extreme cold temperatures can cause significant property damage, mechanical malfunctions and burst pipes.</p> <p>Drought can cause crop failure, depletion of municipal water sources, increase in forest fire risk (see Fire/Explosion Hazard) and insufficient water flow through waterways.</p> <p>Lighting storms can lead to fires (see Fire/Explosion Hazard).</p> <p>Combining heat wave with the dry climate of the Arctic creates ideal conditions for wildfires (see Fire/Explosion Hazard).</p>		

Vulnerability	Description
Communications	A geomagnetic storm can knock out communications and have a variety of effects on technology. Radio waves used for satellite communications or GPS navigation are affected by the increased ionization with disruption of the communication or navigation systems. The high energy particles affect satellites causing failure or equipment damage. The magnetic disturbances directly affect operations that use the magnetic field, such as magnetic surveys, directional drilling, or compass use. Magnetic disturbances also induce electric currents in long conductors such as power lines and pipelines causing power system outages or pipeline corrosion.

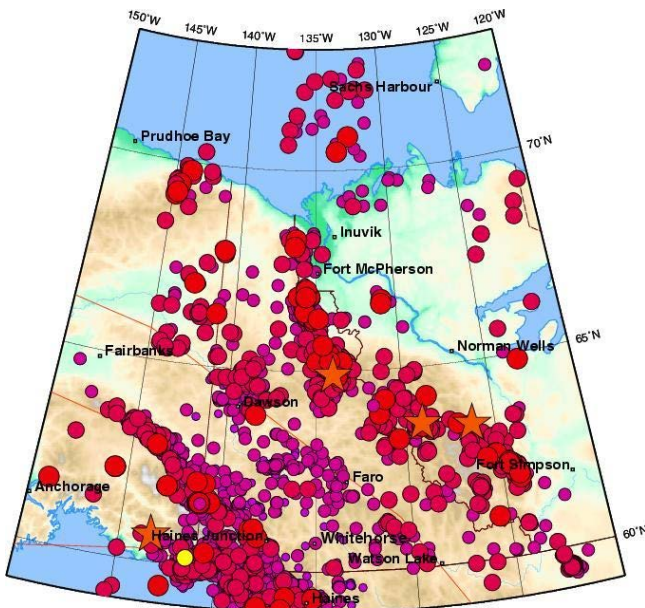
Inuvik Exposure/History

Research did not reveal any specific exposure or history of this hazard in the Inuvik Region. Please review the 2014 NWT HIRA for further information.

Community Meeting Feedback

There was much discussion among residents at all meetings regarding the increase in extreme weather. This mostly included higher temperatures in the summer months and a shifting in seasons. In the town of Inuvik, there have been numerous thunder storms in recent years. In the past, this was almost unheard of in this area.

2.3.4 Earth Movement - Earthquake/ Tsunami

 <p>2008/09/16 - 2013/09/20</p> <p>Recent earthquakes (most recent is shown in yellow)</p> <ul style="list-style-type: none">● M < 2.0● M ≥ 2.0● M ≥ 3.0● M ≥ 4.0★ M ≥ 5.0★ M ≥ 6.0 <p>Figure 19: Earthquakes 2008-2013. (Source: Earthquakes Canada)</p>		Definition A slip along a fault in the earth causing the ground to shake and/or the large wave caused by it	Class Natural Hazard
NWT greatest impacts to date Minor Property damage 1985			
Climate Change Could increase impact			
Mitigation Strategies	<ul style="list-style-type: none">✓ Develop or adopt and enforce building standards for earthquakes.✓ Develop/distribute and facilitate public awareness programs for what to do in the case of an earthquake or tsunami.✓ Ensure that emergency plans are in place.✓ Develop tsunami inundation mapping and hazard zones for at risk communities.✓ Plan and communicate “safe areas” for community members to go to in the event of an earthquake or tsunami.		
Vulnerability	Description		
People	Some injury and possible death may occur due to landslide or structural collapse caused by a major earthquake in the western part of the territory or a tsunami in the Arctic Ocean.		
Infrastructure	Structural damage to buildings and infrastructure could be caused by a major earthquake in the western part of the territory or a tsunami in the Arctic Ocean.		
Communications	Communications could be disrupted by a major earthquake or a tsunami in the Arctic Ocean.		

Inuvik Exposure/History

The northern Rocky Mountain Region is one of the seismically active areas of Canada. Communities in the west of the territory experience minor earthquakes each year which are rarely felt.


The town of Inuvik has a short-period hazard designated as the “stable Canada” region. There is a low-probability of moderate-sized earthquakes. For example, in January, 2008, a 5.8 magnitude earthquake shook buildings but did not cause real damage. This earthquake actually took place in the northern Richardson Mountain range, about 40 kilometres northwest of Fort McPherson. Earthquakes can be felt in Inuvik about once every two years. Inuvik could see earthquakes approaching magnitude 7 at a distance of about 150 km.

A small risk of tsunami on the Arctic Ocean exists.

Community Meeting Feedback

This hazard was not mentioned as a concern at the Inuvik Region meeting.

2.3.5 Food and Agricultural Emergency

		Definition Any emergency which affects food security, food quality or food safety for many people	Class Natural Hazard
<p>Figure 20: The Inuvik Community Greenhouse is one of the largest of its kind in the world. It was converted from the former hockey rink and provides residents with fresh produce grown on 70 plots every summer. (Source: Public Health Agency of Canada, 2009/photo credit Inuvik Community Greenhouse Society)</p>		NWT greatest impacts to date <ul style="list-style-type: none">Food recall	
		Climate Change Projected to increase both frequency and consequence	
Mitigation Strategies	<ul style="list-style-type: none">✓ Ensure disease and recall monitoring plans are in place between all levels of government and private sector.✓ Ensure public awareness information and programs are available from the Federal Government and industry associations.✓ Ensure that response plans include containment and quarantine procedures.		
Vulnerability		Description	
People		People are reliant on a well regulated safe supply of food and agricultural processes. Any emergency caused by a failure of this system can impact on the immediate and long term health of anyone affected.	
Infrastructure		N/A	
Communications		N/A	


Inuvik Exposure/History

Research did not reveal any exposure or history of this hazard in the Inuvik Region. Please review the 2014 NWT HIRA for further information.

Community Meeting Feedback

Concerns were expressed during the meetings in the Inuvik Region over the hazards related to food spoilage.

2.3.6 Civil Unrest

		Definition People breaking the law in order to bring attention to their cause	Class Human-induced Hazard
<p>Figure 21: Drivers of construction vehicles protested regulatory delays on the Inuvik to Tuktoyaktuk Highway project last September. The highway is considered by many in the region to be vital to economic development – January 2013. (Source: NNSL/ file photo)</p>		NWT greatest impacts to date <ul style="list-style-type: none">Fatalities 9Property Damage (Mine)	
		Climate Change Projected to increase both frequency and consequence	
Mitigation Strategies		<ul style="list-style-type: none">✓ Have intelligence and monitoring plans in place with law enforcement and stakeholders.✓ Coordinate integrated response plans with stakeholders.	
Vulnerability	Description		
People	Civil unrest can directly impact the safety and security of individuals or groups of persons whether or not they are targeted by the unrest. There is also a threat of injury to public responders and those persons involved in the unrest.		
Infrastructure	Damage to public and private property is almost always a staple of civil unrest. There is also an increase in cyber terrorism which targets computer systems which control defense establishments as well as public utilities.		
Communications	Acts of civil unrest or terrorism can impact communications which disrupt public authorities’ ability to deal with the unrest.		


Inuvik Exposure/History

Research did not reveal any exposure or history of this hazard in the Inuvik Region. Please review the 2014 NWT HIRA for further information.

Community Meeting Feedback

This hazard was not mentioned as a concern at the Inuvik Region meeting.

2.3.7 War/ International Incident

		Definition An action or clash that results in a wider dispute between two or more nation-states.	Class Human-induced Hazard
		NWT greatest impacts to date N/A	
		Climate Change Projected to increase in frequency	
Mitigation Strategies ✓	✓ Ensure notification and information/communication protocols are in place with Federal Government Departments. ✓ Ensure appropriate emergency plans are in place based on the perceived or real risk of war and potential casualty threats.		
Vulnerability		Description	
People		The main effects of war on people are poverty due to destruction of properties and business, death and property destruction. War can also cause a dramatic impact on civilian health, because of the weapons which may be highly radioactive.	
Infrastructure		The most commonly held thoughts on war's effect on infrastructure is the destruction of roadways, railways and bridges to hamper an enemy's ability to move freely and accumulate forces at a given point. In recent wars there have been specific examples of water and power plants being targeted in order to dramatically impact the ability of a populace to survive in a given area.	
Communications		Communication facilities are likely the first to be targeted in any war or act of war or terrorism. Without communications authorities will be unable to respond to threats coherently and the loss of information can lead to a general state of panic amongst a population.	


Inuvik Exposure/History

Research did not reveal any exposure or history of this hazard in the Inuvik Region. Please review the 2014 NWT HIRA for further information.

Community Meeting Feedback

This hazard was not mentioned as a concern at the Inuvik Region meeting.

2.3.8 Falling Debris

		Definition Any object (such as a satellite) which survives its passage through the Earth's atmosphere and impacts Earth	Class Natural Hazard
Figure 23: First piece of debris found from the crashed Cosmos-954 Soviet satellite, 1978. (Source: Wikipedia)		NWT greatest impacts to date Environmental	
		Climate Change N/A	
Mitigation Strategies	<ul style="list-style-type: none">✓ Have monitoring and notification protocols in place with appropriate agencies (i.e. CSA, NASA, NAV CANADA).✓ Ensure emergency plans are in place for potential risks associated with falling debris.		
Vulnerability		Description	
People		Any object falling to earth from space will be of concern in terms of public safety and there will always be a worry of people being injured or killed by falling debris. Given the low population of the NWT and rare occurrence of these events there is a low likelihood of this happening.	
Infrastructure		Damage to buildings, roads and other infrastructure would be a concern in the event of falling debris.	
Communications		An object which falls from space may impact a communications satellite or microwave tower which could directly impact communications in a region.	

Inuvik Exposure/History

Research did not reveal any exposure or history of this hazard in the Inuvik Region. Please review the 2014 NWT HIRA for further information.

Community Meeting Feedback

This hazard was not mentioned as a concern at the Inuvik Region meeting.

3 Existing Response Capabilities

This section provides a summary of the Inuvik Region's response capabilities that were considered when assessing the regions overall risk to the hazards discussed in Section 2.

3.1 Emergency Response and Preparedness Organizations

Under overall management of the MACA Regional Superintendent, the GNWT is responsible for assisting Local Authorities within the Inuvik Region when requested, or assuming operational control when the Local Authority's capacity or jurisdiction is exceeded. In fulfilling these regional responsibilities the GNWT shall:

- Establish a committee to plan for and respond to emergencies;
- Develop and maintain the Inuvik Regional Emergency Response Plan;
- Implement plans and procedures for an integrated response to emergencies within the Region affected;
- Provide prompt and coordinated response to specific requests for assistance from the Local Authority and/or when the capacity of the Local Authority is exceeded;

The response to most emergencies is managed by the Local Authority, as the community government of the affected community. The Regional Emergency Response Committee is established as the body responsible for the planning and coordination of the area response to emergencies within each region. The Regional Emergency Response Committee provides support and assistance in specific areas as requested by the Local Authority. Should the emergency exceed the capabilities of the Local Authority to respond, or should its jurisdiction be surpassed, the GNWT may assume control of emergency operations in an effort to return conditions to normal under the authority of the Emergency Measures Officer, as the senior territorial emergency official appointed by the Minister Responsible for Civil Emergency Measures.

The GNWT, through the Emergency Measures Organization, is responsible for providing assistance to support regional emergency operations, or assuming operational control when the incident is a matter of GNWT jurisdiction. In fulfilling its headquarters responsibilities the GNWT shall:

- Establish committees, comprised of various designated emergency agencies, to plan for and respond to emergencies;
- Develop and maintain the NWT Emergency Plan;
- Implement procedures for an integrated response to emergencies within any part of the NWT;
- Provide prompt and coordinated response to emergencies to assist regional emergency operations;
- Coordinate the provision of specialized assistance of agencies from the Federal Government and other provinces and territories not provided for in the Plan, and
- Assume direction and control of GNWT emergency operations when the emergency is a matter of Territorial Government jurisdiction.

In accordance with established Government of Canada emergency arrangements, Public Safety Canada (PSC) will assist the GNWT in responding to emergencies in the Northwest Territories. To fulfill its emergency responsibilities PSC has agreed to:

- Appoint a senior representative to TERC; and
- Coordinate the required assistance of federal departments and agencies not resident in the NWT during any GNWT response to emergencies.

Joint Task Force North (JTFN) - in accordance with Canadian Forces (CF) Directive "Provision of Essential Services to Civilian Authorities", JTFN may assist the GNWT in:

- Search and rescue;
- Communications;
- Emergency transportation;
- Provision of manpower and other resources;
- Disposal of hazardous materials; and
- Specialized training within the CF area of expertise.

3.2 Fire

The Fire Chief/Local Assistant is responsible for directing the activities of the Fire Department to ensure that loss of life, property or injury as a result of fire is prevented and/or minimized within each community. The Fire Chief/Local Assistant is the sole authority and command at the scene of a fire.

MACA delivers training to community government fire departments through its School of Community Government.

The Office of the Fire Marshal (OFM) protects the public from loss of life and property as a result of fire. The OFM has direct contact with fire departments and the public across the NWT. The OFM plays a regulatory role by enforcing the *Fire Prevention Act* and its associated regulations, namely, the *Fire Prevention Regulations*, *Fireworks Regulations*, and *Propane Cylinder Storage Regulations*. NWT has adopted Firesmart principles to identify, mitigate and document hazards.

Fire departments in the Inuvik Region are largely composed of volunteers, with only the town of Inuvik employing a full-time fire chief.

Many communities in the NWT experience difficulty in the recruitment of volunteers. Although reasons vary, a significant factor is the training which requires individuals to take time away from home and work for even the basic level.

Wildfire

The Department of Environment and Natural Resources directs the GNWT Forest Fire protection and suppression initiatives to provide:

- Assistance in the provision of and support to mobile/portable radio systems;

- Assistance in the procurement of radio communications equipment;
- Monitoring of weather, forest and fire conditions, forecasting fire behaviour and conditions to guide preparedness arrangements, and managing NWT forest fire suppression operations;
- Advice to the Emergency Management Office and communities on forest fire conditions and behaviour, and recommending appropriate courses of action (seasonal); and
- The requisition of special firefighting and safety equipment, and other specialized materials and supplies which are available (seasonal).

Environment and Natural Resources is working with communities in the NWT to develop and implement Community Wildfire Protection Plans (CWPP). These plans are designed to identify and reduce wildland fire risk in communities. CWPP's are becoming a national standard for agencies and communities responsible for wildland fire management. The process is recognized as a crucial first step in better preparing homeowners and communities to reduce the risk of loss.

Community Wildfire Protection Plans (CWPP) Inuvik Region

Aklavik CWPP 2012
 Fort McPherson CWPP 2012
 Inuvik CWPP 2012
 Tsiigehtchic CWPP 2010

3.3 Police

Police servicing in the NWT is designated as G Division and is split into a North and South District. There are currently seven RCMP Detachments in the Inuvik Region:

- Aklavik Detachment;
- Fort McPherson Detachment – also services the community of Tsiigehtchic;
- Inuvik Detachment;
- Paulatuk Detachment;
- Sachs Harbour Detachment;
- Tuktoyaktuk Detachment; and
- Ulukhaktok Detachment.

3.4 Medical and Health Authorities

Beaufort-Delta Health and Social Services Authority (BDHSSA)

The BDHSSA operate the Inuvik Regional Hospital (51-bed hospital), 8 health centres and community based health and social services programs throughout the Inuvik Region. It includes:

- Nine practicing physicians;
- Seven remote health centers;
- Seven remote social services locations;
- Three group homes; and
- Two seniors care facilities.

Ground Ambulance and Highway Rescue Services

The Town of Inuvik operates a community-based ground ambulance service through a private contractor. In light of the necessary resources, capacity, equipment and training, Health and Social Services Authorities generally do not provide support for ground ambulance services within communities or on NWT highways. Inuvik also provides both highway ambulance and rescue services within a prescribed distance of their home community.

The GNWT utilizes a Highway Emergency Alerting Protocol (HEAP) to assist the RCMP and community Fire Departments in responding to vehicular accidents on territorial highways and winter roads. The Protocol describes a uniform plan for emergency response to highway accidents in various zones designated across the NWT. It guides the following activity:

- Establishing command authority;
- Dispatching resources;
- Accident reporting;
- Emergency landing procedures; and
- Clarifying medevac coverage areas.

The Stanton Territory Health Authority coordinates inter-facility and medevac services for the territory, including the Inuvik region.

3.5 Search and Rescue

SAR response to	Primary	Secondary
Aircraft incidents	Canadian Forces	RCMP Civil Air Search and Rescue Association (CASARA) Search and Rescue Volunteer Association of Canada (SARVAC) Any multi-tasked Federal aircraft or vessel
Marine incidents in tidal and international waters	Canadian Coast Guard	Canadian Forces Canadian Coast Guard Auxiliary (CCGA) Search and Rescue Volunteer Association of Canada (SARVAC) Any multi-tasked Federal aircraft or vessel Police force of jurisdiction Vessel of opportunity

SAR response to	Primary	Secondary
Ground and inland water incidents	Parks Canada within National Parks, Crown owned land – military bases and training areas Territorial responsibility delegated to RCMP	Canadian Forces Canadian Coast Guard Any multi-tasked Federal aircraft or vessel Civil Air Search and Rescue Association (CASARA) Canadian Coast Guard Auxiliary (CCGA) Search and Rescue Volunteer Association of Canada (SARVAC)

Organization	SAR Responsibility
Royal Canadian Mounted Police	Coordination of public ground search and rescue (including inland waters).
Canadian Forces	Humanitarian assistance including air and marine search and rescue.
Fisheries and Oceans (Coast Guard)	Marine emergency alerting including ship spills and marine search and rescue under coordination of the National Search and Rescue Program and support of marine search and rescue volunteer training under the coordination of the National Search and Rescue Program.
Transportation Canada	Air search and rescue alerting and support of air search and rescue volunteer training under the coordination of the National Search and Rescue Program.
Park Canada Agency	Available to provide professional advice and support on search and rescue.

3.6 Canadian Forces

Headquartered in Yellowknife, NWT, JTFN is responsible for Canadian Joint Operations Command's single largest region by far. In fact, JTFN's area of responsibility encompasses approximately four million square kilometres, or 40 per cent of Canada's land mass, and 75 per cent of its coastal regions.

Created as part of a broader transformation of the Canadian Forces in 2006, JTFN is one of 6 regional Joint Task Forces across Canada, and reports directly to Canadian Joint Operations Command, located in Ottawa, Ontario.

In addition to its headquarters located in Yellowknife, NWT, JTFN maintains detachments in Whitehorse, Yukon, and Iqaluit, Nunavut.

JTFN is responsible for the command of the Canadian Rangers in the North through the 1st Canadian Ranger Patrol Group and supports the Cadet program and the Junior Canadian Rangers program in the three territories.

In total, there are approximately 250 Regular Force, Reserve Force and civilian personnel who are working north of the 60th parallel within one of the following units:

- JTFN Headquarters and its two detachments in Iqaluit and Whitehorse;
- Area Support Unit (North);
- 1st Canadian Ranger Patrol Group;
- 440 (Transport) Squadron;
- 1 Field Ambulance Detachment; and
- C Company of the Loyal Edmonton Regiment.

Inuvik Region Communities with a Ranger Patrol
Inuvik
Fort McPherson
Paulatuk
Tsiigehtchic
Tuktoyaktuk
Ulukhaktok



Figure 24: 1st Canadian Ranger Patrol Group in NWT
(Source: Government of Canada, Canadian Army website)

4 HIRA Conclusions

This type of assessment is a critical part of any emergency management program. Identified hazards can be used in preparedness programs, emergency response plan exercises, and training and awareness programs.

Qualitative data, definitions and more extensive analysis of each hazard is provided in the 2014 NWT HIRA Section 5 Hazard Narratives. Other regional summaries are contained in Appendix 8.7, which provides communities with a more locally focused risk assessment.

Hazards are interconnected, fluid, not subject to regional and territorial boundaries and may have unique outcomes. The Inuvik Region HIRA should be updated routinely when new information about hazards that could impact the Inuvik Region becomes available.