BELLA COOLA EMERGENCY RESPONSE PLAN

ANNEX C:
HAZARD RISK & VULNERABILITY ANALYSIS

January, 2018

Updated by:
Frontier Resource Management Ltd

Bella Coola
Hazard Risk & Vulnerability Analysis

Contents

1 Introduction

The hazard potential for the Bella Coola valley was assessed using Emergency Management BC's web based Hazard, Risk and Vulnerability Analysis (HRVA) tool (V January, 2007) for each of the hazards having potential to cause emergencies of the scale necessary to invoke the Bella Coola Emergency Plan. Input data for the analysis was acquired through interviews with local agencies, previous emergency plans, various studies and experienced knowledge of the plan authors. For each hazard a risk index is generated based on the severity potential and estimated frequency. The input data for each hazard are provided in Appendix 1. The results of this analysis form the Hazard Profile for the Bella Coola valley community.

It should be noted that this hazard evaluation system is done using a Provincial scale and therefore a severity potential ranking of 'low' may be very high on a relative basis at the local level.

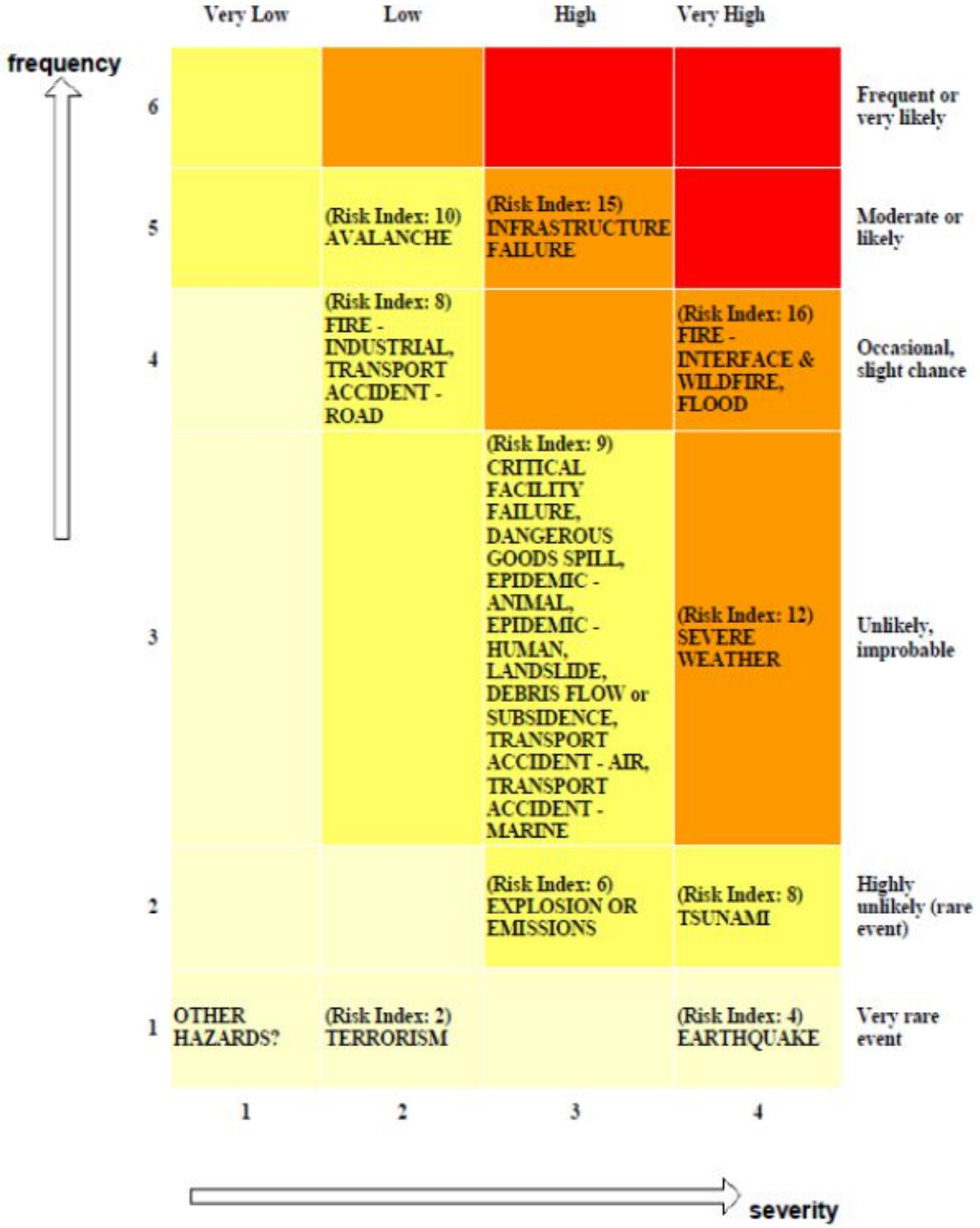
Table 1 summarizes the main hazards facing Bella Coola and their relative risk priority using the HRVA tool.

Table 1 – Hazard Priority Summary

PRIORITY	HAZARD & RISK INDEX
1	(Risk Index: 16) FIRE – INTERFACE & WILDFIRE, FLOOD
2	(Risk Index: 15) INFRASTRUCTURE FAILURE
3	(Risk Index: 12) SEVERE WEATHER
4	(Risk Index: 10) AVALANCHE
5	(Risk Index: 9) CRITICAL FACILITY FAILURE, DANGEROUS GOOD SPILL, EPIDEMIC – HUMAN, LANDSLIDE/DEBRIS FLOW, TRANSPORT ACCIDENT – AIR & MARINE
6	(Risk Index: 8) TSUNAMI
7	(Risk Index: 8) TRANSPORT ACCIDENT - ROAD
8	(Risk Index: 6) EXPLOSION OR EMISSIONS

9 (Risk Index: 4) EARTHQUAKE

Bella Coola Hazard Risk Profile



2 Flooding

Risk Index: 16
Severity Potential: Very High
Frequency: Occasional, slight chance
(return period every 10-30 years).

Flooding is a major concern in the Bella Coola valley as most residences and infrastructure are at some level of risk from flooding of the Bella Coola River and/or tributary rivers and creeks. Historically, it is the most frequent significant emergency in the Valley. There have been significant flood threats at least every decade. The increase in settlement in the Valley makes any new flood potentially more damaging than the last. See Emergency Base Maps in Annex D 2 for information on flood prone areas.

Floods are generally seasonal occurring primarily in Fall to early Winter. The onset of Bella Coola River flooding is generally slow, usually building after a few days of torrential rains. However, flood conditions can occur rapidly during rain on snow events. Effects can range from minor inconvenience to severe destruction. Small or large areas of the Valley may be affected, for periods of days to weeks. Even in mild flooding conditions, Hwy 20 is likely to be submerged in several places. Debris carried by flood waters place bridges in jeopardy. Some protection for property is gained from dikes, but in severe flooding, dikes may give way or become counterproductive by holding water in after it has overtopped them. If dikes are breached, much of Hagensborg, including the Mercantile store, The Legion, Mecham's Service, the School Board Offices, NES and SAMSS, and the Airport, may be flooded.

Telecommunications and power may be lost in severe flooding: however, access and property destruction are main concerns. Water supplies can also become contaminated. Road access to/out of the valley may be prevented along with access to hospital and critical lifeline services. If the Valley is cut off, food, medical, and other supplies will be rapidly depleted. Floodwaters will damage and destroy property, and large numbers of people may be displaced. There may be limited human mortality and some livestock may be lost. Multiple stresses will fatigue victims and responders. After a severe flood, cleanup problems will be significant.

It should also be noted that much of the valley properties that are not in the river's floodplain are on the alluvial fans of one creek or another; and if the river is in flood, it is likely that these creeks will also be flooding or torrenting. For example, Bella Coola (town site and village) is almost entirely out of the flood plain, but entirely within Tatsquan Creek's Alluvial Fan. Other key alluvial fan areas are Thorsen creek (4 Mile Reserve), Snooka creek, Snootli and Nookliklonic (Hagensborg), Nusatsum River (Smith sub-division) and Salloompt River. Geological Survey Branch has disclosed a heightened potential flood hazard on the Noosgulch River where a large area of bedrock is apparently ready to fall into the river after only a minor earth tremor. The quantity of material is likely sufficient to temporarily dam the river, creating the danger of

flash flooding for people living downstream in the Bella Coola Valley close to the confluence with the Noosgulch.

2.1 *Hazard Reduction*

Flood hazard reduction measures in Bella Coola include:

- Regular review and updates to Emergency Response Plan.
- Acquire detailed river mapping showing hydrological changes to river system to inform detailed risk assessment
- Develop plan for maintaining existing river dikes, river guarding, new dikes and bedload reduction.
- Public education.
- Coordinated Communication and Evacuation Plan.
- Appropriate placement and rapid deployment of heavy machinery.
- Limit new construction on flood prone areas
- Continuous program of clearing gravel bed- load build up in proximity to key bridges.

3 Fire – Wildland and Urban Interface

Risk Index: 16
Severity Potential: Very high
Frequency: Occasional, slight change (return period every 10-30 years)

Wildland and urban interface (homes and businesses built among trees) fire is potentially the most severe emergency threat that the Bella Coola valley community faces. Fires can start without little warning and, under the right conditions, can spread very quickly to affect the whole valley. The rapid nature by which this emergency can develop and the devastating harm it can cause makes this one of the most challenging emergency response situations that the valley faces. Accordingly, prevention is paramount and the implementation of a 'Firesmart' community program is recommended to help reduce the hazard.

The Bella Coola valley is located in the dry sub-maritime ecosystem where forest fire is a natural process of forest renewal. The natural return interval for fire in this ecosystem is around 200 years on average and fires may range in size from a few hectares to over 1000 ha. Virtually all of Bella Coola residences and businesses are located in, or near, the wildland/urban interface fire zone and are consequently at risk.

Fire risk is highest in summer months from June through September although hot, dry weather conditions in April and October also give cause for alarm. Of particular concern is the high danger created during dry summer periods when the westerly in-flow winds are strong. A fire started in the lower valley during one of these periods can quickly race up valley. Human activities, like grass or slash burning, smoking, camp fires and

garbage dump burning, pose the highest risk for initiating a fire, although lightning also poses a significant threat.

Fires can last for a few days to a number of weeks so there could be prolonged disruption in the valley. Forest fires generate a tremendous amount of smoke and given the valley's narrow geography, smoke can pose a significant respiratory threat as well as limiting visibility for traffic and aircraft. Power and telephone disruptions can be expected as power lines are suspended on wooden poles. Roads may become impassable due to fallen trees or intense smoke and heat. Evacuations of people and livestock are likely and homes and infrastructure may be lost. Restoration and clean up efforts can be sizeable and prolonged.

The Bella Coola town site and 4 Mile Reserve areas have less tree cover than most other inhabited areas of the valley and therefore the risk is slightly lower. However, the potential for house-to-house fire is higher in these relatively dense areas. The prevailing summertime winds flow up valley, placing areas east of Thorsen Creek at higher risk. The narrowing of the valley in the Glacier View area (Noosgulch), causes winds to speed up through this area, thereby increasing the rate of fire spread potential up to and including Firvale. Moisture conditions get drier in the eastern part of the valley thus increasing the risk to Stuie and areas in Tweedsmuir Park.

Local volunteer fire departments have a mutual aid agreement that enables each department to assist the other departments. The Fire Departments are only equipped to control structural fires before they spread to other structures or to the forest. Some people have their own compliments of fire equipment, including pumps and hose but rapid deployment of these would be sporadic and undependable. Resources in terms of equipment, expertise and labour from outside the valley will be necessary in order to fight anything but the smallest interface fire.

The BC Wildfire Service provides wildfire suppression services for the Province and during the fire season initial attack crews are stationed in Hagensborg during times of fire risk. As has happened on numerous occasions over the last 10 years, large crews, equipment and air support has been quickly mobilized to Bella Coola to control wildfires in the area.

3.1 *Hazard Reduction Strategies*

There are a number of initiatives available to help the community prevent and prepare for wildlfire or interface fire:

- Adopt and promote Firesmart Program (see BC Wildfire Service website)
- Public education.
- Regularly review and update the community Interface Fire Plan
- Inform public about fire hazard weather conditions, burning restrictions and activity restrictions
- Promote forest fuel reduction strategies on private and public forest lands.

4 Infrastructure Failure

Risk Index: 15
Severity Potential: High
Frequency: Moderate or likely (every 3 – 10 years)

Electrical power, water, telephone:
Short power outages are relatively common in the valley and occur a number of times every year. The hospital has back up power generation capacity and is able to function through these periods. Winter is the main time for concern of prolonged power failure as furnaces, well pumps and sump pumps rely on electric power. Many homes have wood as primary or back up heat but there are a number of dwellings that do not, particularly government and multi-family housing units. Food refrigeration would not necessarily be a problem in winter, however, a prolonged power outage in summer could pose significant problems for food stores and many people who store their yearly supply of salmon and hunting meat in their freezers. Cooking could also pose a problem for many as electric stoves and ovens are the norm. Communication links would also be affected as internet service would be disrupted as would telephone use.

4.1 *Hazard Reduction Strategies*

Hazard reduction from power outages is primarily through public education and promotion of safe home-based backup systems:

- Power supplies (small generators, batteries)
- Wood furnace
- Gas/propane cooking stoves (camping stoves)
- Regular preventative clearing and pruning of problem trees in vicinity of hydro and telephone lines.

5 Severe Weather

Risk Index: 12
Severity Potential: Very High
Frequency: Unlikely, improbable (every 30-100 years)

Hurricane, ice storm, severe outflow
Main concern is hurricane force winds, heavy ice storms, extreme snow events and prolonged periods of frigid temperatures. Storms can occur at any time of year, however stormy conditions are more common during fall and winter. With global warming, extreme weather events are becoming more common, so severe weather hazards can be expected to increase in the future. Strong winter outflow storms typically occur every year and these may cause localized damage and inconvenience.

Much of the valley is forested and there may be extensive wind throw of trees knocking down power and telephone lines as well as blocking roads. Falling trees also pose a significant danger to people and structures. It may take days or more than a week to restore power to all parts of the valley, so if this occurs in winter it may place many people in peril as described with infrastructure failure hazards.

Storms often initiate other problems like flooding, avalanches, lightning caused fires and landslides thus compounding the emergency. Problems may include damage to water, power and telecommunications lines, interruption of road and air traffic, and possible isolation of all or parts of the community. There may be loss of life for anyone caught out on the roads or at sea, and hardship for people isolated in their homes without adequate food, heat, or water. Fortunately, people in the Valley tend to be self-reliant, and most have at least some food and wood backup for heat.

Drought is not thought to be of much concern, although some wells may go dry from time to time, but this is not likely to generate a community emergency.

5.1 *Hazard Reduction Strategies*

Hazard reduction of damage from weather storms is primarily through public preparedness education. Promote installation of:

- Household emergency kits.
- Household generators
- Safe alternate heating and cooking amenities.
- Battery powered radio.

Other mitigative measures are to conduct a regular program of pre-emptive brush, limb and tree clearing in vicinity of power and telephone lines, already being done by public utility providers.

6 Avalanche

Risk Index: 10
Severity Potential: Low
Frequency: Moderate or likely**,** (every 3-10 years)

Steep mountainsides mean there is always a potential for snow slides. Snow avalanches will have adverse effects on the areas they fall on, ranging from destruction of life and property to disruption of power and telephone lines and roads. They may also contribute to wider problems, if they cause temporary damming of a watercourse, with subsequent flooding. Areas at risk from avalanche dangers are fairly site specific and avalanche chutes that frequently pose a threat are identified on the Emergency Base Maps in Annex D.

Avalanches are usually associated with heavy snow and/or rain events; however, they may also be triggered by earth tremors.

Of particular concern to Bella Coola is the potential for prolonged closure of Hwy 20 due to large snow slide on 'The Hill', thus preventing transport of essential supplies like food and fuel. In this case, alternative transport, likely by plane, barge or ferry, would have to be arranged in short order.

6.1 *Avalanche Hazard Reduction Strategy*

Ministry of Transportation and Infrastructure maintain two snow depth monitoring stations that are used to assess avalanche danger. When avalanche risk is high, then mitigation measures may be taken by deliberately initiating avalanches under controlled circumstances to relieve snow pack loading. There are also road block booms on Hwy 20 at the bottom of the Hill and immediately west of Bella Coola to block off traffic on these avalanche prone areas when risk is high or avalanches are being triggered.

7 Critical Facility Failure

Risk Index: 9
Severity Potential: High
Frequency: Unlikely, improbable (every 30 – 100 years)

Critical facilities include the general hospital and clinic, RCMP station, schools, CCRD and Nuxalk Nation admin buildings and the local Credit Union. If these facilities were to become unusable, the consequences reach throughout the community. Failure of these facilities may be caused by fire, flood, earthquake or tsunami.

7.1 *Hazard Reduction Strategies*

Hazard reduction of critical facility failure entails:

- Relocation Contingency Plans for maintaining continuity of service at other locations
- Promote, install and maintain structure fire suppression systems
- Promote earthquake proof construction of critical facilities

8 Dangerous Goods Spill

Risk Index: 9
Severity Potential: High
Frequency: Unlikely, improbable (every 10 – 30 years).

Because the Valley is not heavily industrialized, the main chemical spills will likely be fuel (gasoline, diesel, or propane). The main fuel storage sites are Columbia Fuel's tank farm at the harbour, gas stations in Bella Coola, 4 Mile and Hagensborg and BC Hydro's diesel power generation plant near 4 Mile reserve. Fuel spills are most likely to occur during transport and fuel is brought in by barge to the Shell tank farm and also by tanker truck down the hill.

An ammonia leak at the Ice Plant by the harbor is also a potentially very dangerous possibility. From time to time, other hazardous material may be brought into the valley for specific purposes like paving or the material may only be transported through the valley on its way to outer coast destinations. Hazards from any spill will include contamination of the environment, toxic exposure to humans and animals, and explosion and fire. There may also be temporary disruption of travel, and interruption of phone and power lines. Containment of the hazard will be a priority, and evacuation may be necessary.

8.1 *Hazard Reduction Strategies*

Hazard reduction strategies for harmful materials spills is primarily the responsibility of the material storage or handling vendor and associated agencies. Columbia Fuel maintains a trailer at the harbour which contains emergency fuel spill control and clean up material (booms, soaker pads, etc).

Vendors should be encouraged to advise the CCRD of any situation requiring the potential involvement of emergency personnel (eg exceptionally large fuel transfers or construction projects relating to fuel storage).

Community initiatives that will help reduce hazard are:

- Promotion of safe storage and handling practices
- Build capacity to handle spill control and clean up.
- Establish system for vendors to notify CCRD of the transport of hazardous material that are unusual for the area and particularly dangerous to population (ie chlorine gas).

9 Epidemic - Human

Risk Index: 9
Severity Potential: High
Frequency: Unlikely, improbable (every 30 – 100 years)

The World Health Organization and the US Centre for Disease Control both state that the threat of impending global pandemic is very real. British Columbia is recognized as being vulnerable to the spread of disease due to the large volumes of travellers that make the populated areas of the province their destination.

Bella Coola's isolation has both positive and negative benefits in relation to disease and epidemics. Because it is not a heavily populated area with large numbers of people traveling through it, the community is not as exposed to disease originating from distant shores. On the other hand, because it is a close knit community, infectious disease can spread very quickly to affect a significant number of residents, thus potentially disabling the community's ability to provide essential services. The community's isolation and limited points of entry may provide some defence against a pandemic threat affecting British Columbia, but if this was to occur, the community would have to limit outside access and provide much of its food and other supply needs locally. House quarantine or other forms of confinement may be a requirement in severe cases. In the event of a pandemic, Bella Coola should not expect much help from the outside as larger populations at risk would receive priority with regards to medical, or other, assistance.

9.1 *Hazard Reduction Strategies*

Local health services are responsible for addressing disease issues through their emergency plans. The Bella Coola Emergency Program must work closely with the local health authority and provide support wherever it is required. A pandemic outbreak would require the community to be self reliant for an extended period of time and this would require stocking up of non-perishable foods and rationing of essential supplies. All residents of the community must also be encouraged to obtain flu vaccinations each year and the health authority must be supported in its efforts to receive sufficient vaccine supply.

It is important that the essential service providers in the community are provided protection (vaccinations, personal protective equipment) as a priority at the onset of an epidemic/pandemic emergency.

10 Landslides and Debris Flows

Risk Index: 9
Severity Potential: High
Frequency: Unlikely, improbable, (every 30-100 years)

Steep mountainsides mean there is always a potential for land (soil or rock) slides. These will have adverse effects on the areas they fall on, ranging from destruction of life and property to disruption of power and telephone lines and roads. They may also contribute to wider problems, if they cause temporary damming of a watercourse, with subsequent flooding.

Land slides and debris flows are usually associated with heavy snow and/or rain events; however, they may also be triggered by earth tremors.

Of particular concern to Bella Coola is the potential for prolonged closure of Hwy 20 due to large land slide or road collapse on 'The Hill', thus preventing transport of essential

supplies like food and fuel. In this case, alternative transport, likely by plane, barge or ferry would need to be arranged in short order.

10.1 *Hazard Reduction Strategies*

Hazard reduction strategies entail:

- Promotion of terrain stability assessments above key facilities and transportation infrastructure
- Incorporate landslide risk into land zoning

11 Transport Accidents - Air

Risk Index: 9
Severity Potential: High
Frequency: Unlikely, improbable (every 30 -100 years)

The effects of an air-crash may vary tremendously, depending on the size of the aircraft and where it comes down. Problems may include severe injury or death for passengers and/or persons on the ground, and destruction of property, by impact or by subsequent fire. Difficult search and rescue may be required, and multiple victims and casualties will strain the local hospital's capacity to provide care. Bella Coola relies heavily on air transportation, and a particular problem would exist if an air disaster were to cause the closure of the Bella Coola airport. Outside helicopter assistance would likely be required to transport seriously injured persons should the air-ambulance be unable to use the existing airstrip.

At present, air traffic activity in the Bella Coola valley is relatively light with only three service providers. Summer months are busier although winter heli skiing is increasing helicopter traffic February-March. The following is a summary of the local flight industry.

Airline	Aircraft	Service	# Passengers	# Pilots
Pacific Coastal	Beech 1900	1-2 times daily	19	2
West Coast Helicopters	A-Star	Charter	6	1
Other	Miscellaneous	Charter	3-19	1-2

11.1 *Hazard Reduction Strategies*

Hazard reduction strategies for accidents are primarily the responsibility of the various transportation service providers and associated agencies. Potential hazard reduction strategies include:

- Train Hagensborg fire department in attending aircraft accidents

- Capacity building to handle transportation and care of multiple victims involved in accidents

12 Transport Accident - Marine

If a large vessel such as the Ferry were to run into trouble near Bella Coola, local resources might be called on to help with rescue. Once ashore, passengers, if injured, would place demands on the ambulances and hospital; if healthy, they would require temporary accommodation and basic supplies. Other more complicated scenarios are imaginable: for example, a large vessel (or fuel barge) might collide with the dock and start a fire. Storms may endanger fishing fleets or multiple recreational boaters thereby straining search and rescue resources.

12.1 *Hazard Reduction Strategies*

Hazard reduction strategies for accidents is primarily the responsibility of the various transportation service providers and associated agencies. However, community initiatives that will help reduce hazard are:

- Promotion of safe driving and boating

Build capacity to handle transportation and care of multiple victims involved in accidents

13 Tsunami

Risk Index: 8
Severity Potential: Very high
Frequency: Highly unlikely, rare event (every 100-200 years)

Tsunamis, or tidal waves, are unusually big waves generated from a disturbance in the ocean. Typically caused by an earthquake on the ocean floor, tsunamis can also be caused by near shore land slides or even meteorites from space. Bella Coola is at risk from both ocean generated waves and inshore waves caused by massive landslides. By monitoring earthquake activity, EMBC operates a Tsunami warning system for the coast of British Columbia and depending on the type of initiating event, the alert time can range from a number of hours to no forewarning at all. Wave travel time from likely tsunami sources in the ocean is estimated at five – six hours. However, a near- shore sub-duction earthquake or a massive land slide occurring in Burke Channel, North or South Bentinck Arm would provide no time for evacuation alert.

Therefore, if people experience a hard shaking earthquake for more than 15-20 seconds, they should immediately head for high ground at least 20 m. elevation above sea level or east of Stiles Road (RCMP houses).

Due to the outer islands and geography of the inlets, Bella Coola is somewhat protected from the full brunt of an ocean generated tsunami. The Flood Plain Mapping of the Bella Coola valley conducted by the Province in 1989 indicates a tsunami flood level of 5.2 m for North Bentinck Arm. Assuming a worst case scenario of occurrence during high tide, the tsunami flood could reach a level of approximately 11 m above sea level. This corresponds approximately to the river flood plain elevation in vicinity of the 4 Mile cemetery (see Emergency Base Map in Section 2). However, an inshore tsunami generated from a massive land slide along one of the inlets has the potential to be much greater in height, although it is felt that the chance of this occurrence is very unlikely.

The most at risk areas for damage from a tsunami are the shoreline installations at the harbour, Clayton Falls dry land sorts, Tallheo cannery and some private dwellings along North Bentinck Arm (Whiskey Bay). The flood plain mapping conducted by Environment Canada and Ministry of Environment in 1989 estimated the North Bentinck Arm tsunami flood level at 5.2 m. At the Bella Coola town site, areas below Mackenzie St. are potentially at risk from such a tsunami occurring at high tide. Effects from a tsunami can range from drowning to destruction of infrastructure and water damage similar to flooding.

When evacuating due to threat of tsunami, the general rule of thumb for coastal BC is to evacuate to locations at least 20 m above sea level.

13.1 *Tsunami Hazard Reduction*

- Regular update the Emergency Response Plan.
- Public education.
- Coordinated Alerting and Evacuation Procedures.
- Post signs for evacuation routes to safe areas.

14 Transport Accident - Road

Risk Index: 8
Severity Potential: Low
Frequency: Occasional, slight chance (every 10 – 30 years)

Any vehicular accident involving either numerous family vehicles, buses or any other combination of multi-passenger vehicles has the potential to place serious demands upon both the hospital and ambulance services. If such an event were to occur, the EEC may not be required to declare a disaster but first aid resources and emergency transportation vehicles from all sources may be called upon. With growing tourism, more and more tour buses visit the valley, thereby increasing the potential for accidents involving many people. Emergency Social Services would likely be activated to assist with accommodation and support for surviving passengers.

Other emergencies/disasters are possible; the above represent the most likely or most potentially serious.

14.1 *Hazard Reduction Strategies*

Hazard reduction strategies for accidents is primarily the responsibility of the various transportation service providers and associated agencies. However, community initiatives that will help reduce hazard are:

- Promotion of safe driving
- Build capacity to handle transportation and care of multiple victims involved in accidents

15 Explosions & Dangerous Goods

Risk Index: 6
Severity Potential: High
Frequency: Highly unlikely, rare event (every 100 – 200 years)

The Bella Coola valley is not heavily industrialized, so the risk of a serious explosion occurring is low. Use of explosives is limited and primarily related to logging road construction and occasional major works projects like rip rap rock procurement and site preparation. Vendors using explosives are required to follow strict rules for storage, record keeping and magazine facility standards. The potential for other explosions are primarily related to fuel transport or storage facilities like Columbia Fuel's oil tank farm at the harbour or gas stations. A propane explosion is also a possibility as there are a number of homes that rely on propane for heat. Except for an explosion at the harbour or on the Bella Coola town site, an explosion would likely not affect more than one or two structures.

The ice plant at the harbour does use ammonia gas for producing ice for the fishing fleet. With westerly winds predominant during the fishing season, the marina and Bella Coola town site is located down wind from this facility. The Harbour Authority is in charge of the ice plant and is expected to have their own contingency plans to deal with ammonia leaks.

15.1 *Hazard Reduction Strategies*

Reduction of explosion hazard is primarily the responsibility of the user, service provider and associated agencies. Community initiatives that will help reduce hazard are:

- Promotion of safe storage and handling practices.
- Build capacity to handle explosion response.
- Establish system for vendors to notify CCRD of the transport and storage of significant amounts of explosive materials.

- Promote safe storage and handling of ammonia at the harbour ice plant.

16 Earthquake

Risk Index: 4
Severity Potential: Very high
Frequency: Very rare event (every 200-300 years)

Although Bella Coola's rugged geography is the result of cracked bedrock uplifted by the forces of tectonic plates grinding against each other, there have been no significant recorded earthquake in the Bella Coola Valley itself. However, there have been two quakes of magnitude 3.0 to 4.9 in the Kimsquit area in the last thirty years. The Queen Charlotte fault, located out in the Pacific Ocean, is the nearest active fault line posing the greatest threat to Bella Coola.

Tremors from distant earthquakes have been felt in Bella Coola. Canada's largest earthquake (magnitude 8.1 Richter) took place in the Queen Charlotte Islands in 1949, and was felt widely over western North America. A magnitude 7.3 quake happened in Central Vancouver Island in 1946 and caused extensive damage along eastern Vancouver Island. An earthquake capable of structural damage (greater than 5 on the Richter scale) can be expected to strike somewhere in southwestern British Columbia once every ten years, and there are predictions that a very serious (8 to 9) earthquake is overdue for the Lower Mainland - Vancouver Island region. Such a quake would likely cause some problems in Bella Coola in terms of structural shake damage and disruption of power, communication and supply lines. Earthquakes can also trigger fires, however, the greatest threat of damage from earthquake in Bella Coola would likely result from an associated tsunami or landslide.

Earthquakes are unpredictable. They provide no warning and their effects are immediate. An earthquake lasts from 30 seconds to 2 minutes, and there may be aftershocks intermittently for days. Possible effects include damage to buildings, roads and runways, power and telephone lines, fuel lines, water lines and sewage systems; diversion of stream channels, and blockage of streams with subsequent flooding. Damage may be minor or nearly total, local or regional. Debris removal and cleanup will be a concern after the event.

A large event would have coast wide implications which would strain provincial emergency resources and Bella Coola may be without help for some time as larger population centers would receive priority response.

16.1 *Hazard Reduction Strategies*

Hazard reduction from earthquakes is primarily addressed through tsunami hazard reduction strategies.

- Check status of schools/hospital in terms of earthquake proof buildings by agencies responsible.

17 Other Hazards

Other hazards that were considered but determined to be of minor concern to Bella Coola Valley communities and therefore not addressed in the emergency plan are:

- Dam failure
- Mine accident
- Storm surge (ocean)
- Terrorism
- Volcano
- Nuclear accident
- Tornado, lightning, hailstorms

Appendix 1 – Bella Coola Hazard Risk Vulnerability Analysis Data

Appendix 1 - Bella Coola Hazard Risk and Vulnerability Analysis Annex

November, 2017

HAZARD		CONSEQUENCE				LIKELYHOOD		RISK PRIORITY
	Description	Vulnerability & Impact	Description	Assessment	Rank	Rating	Description	
Avalanche	Main avalanche threat areas are known and monitored by MOTI, main concern is hwy closure	Vulnerable populations	Elderly, children, handicapped	No	Low	Moderate or likely	Occurs every 3-10 years	
		Vulnerable areas close to hazard	Infrastructure, buildings	No				
		Inadequate alert or evac plans	Hwy booms, monitoring	No				
		Limited capability to respond or recover	Equipment available to clear	No				
		Dated risk analysis, response recovery plans	MOTI monitors snow levels	No				
		Inadequate hazard specific contingency plans		No				
		Potential extent of deaths	0-4	Very low				
		Potential extent of injury	0-4	Very low				
		Potential extent of damage or loss to critical infrastructure	Access to hospital, schools, police cut off, temporary relocation	Very low				
		Potential extent of damage or loss to lifelines	Damage and closure of hwy for a few days	Low				
		Potential extent of property damage or loss	Localized damage	Low				
		Potential extent of damage or loss to environment	Minimal damage, established avalanche tracts	Very low				
		Potential extent of economic or social impact	Temporary impact	Very low				
Flood	Much of the valley community located on 200 year flood plain.	Vulnerable populations	Elderly, children & poor people exposed	Yes	Very high	Occasional slight chance	Every 10 - 30 years	
		Vulnerable areas close to hazard	Infrastructure exposed	Yes				
		Inadequate alert or evac plans	10 years old, inadequate personnel to alert	Yes				
		Limited capability to respond or recover		Yes				
		Dated risk analysis, response recovery plans	Over 10 years old	Yes				
		Inadequate hazard specific contingency plans	Need updated flood mapping	Yes				
		Potential extent of deaths	0-4	Very low				
		Potential extent of injury	4-50	Low				
		Potential extent of damage or loss to critical infrastructure	Loss of 50% capability	High				
		Potential extent of damage or loss to lifelines	Interuption of one week	High				
		Potential extent of property damage or loss	Wide spread and severe	Very high				
		Potential extent of damage or loss to environment	Wide spread and severe, salmon spawning grounds	Very high				
		Potential extent of economic or social impact	Extended and widespread	High				

HAZARD		CONSEQUENCE				LIKELYHOOD		RISK PRIORITY
	Description	Vulnerability & Impact	Description	Assessment	Rank	Rating	Description	
Critical Facility Failure	**Hospital, police, fire, shelters, schools, gov admin, closure due to fire, collapse**	**Vulnerable populations**	Elderly, sick,	Yes	High	Unlikely, improbable	Every 30 -100 years	
		Vulnerable areas close to hazard	School next to hospital	Yes				
		Inadequate alert or evac plans	Hospital & school has evac plans	No				
		Limited capability to respond or recover	No supporting infrastructure	Yes				
		Dated risk analysis, response recovery plans	Check with agencies	Not sure				
		Inadequate hazard specific contingency plans	Check with agencies	Not sure				
		Potential extent of deaths	0-4	Very low				
		Potential extent of injury	4-50	Low				
		Potential extent of damage or loss to critical infrastructure	Loss of 50% capability	High				
		Potential extent of damage or loss to lifelines	Temporary interuption	Very low				
		Potential extent of property damage or loss	Localized damage	Low				
		Potential extent of damage or loss to environment	Minimal damage	Very low				
		Potential extent of economic or social impact	Temporary and widespread	Low				
Dangerous Good Spill	**Primary dangerous goods is fuel in moderate sized tanks.**	**Vulnerable populations**	Gas stations, BC Hydro generators close to residences	Yes	High	Unlikely, improbable	Every 30 -100 years	
		Vulnerable areas close to hazard	Harbour, townsite	Yes				
		Inadequate alert or evac plans	Check with Columbia fuels	Not sure				
		Limited capability to respond or recover	Spill kit at harbour	Yes				
		Dated risk analysis, response recovery plans	Check with Columbia fuels	Not sure				
		Inadequate hazard specific contingency plans	Check with Columbia fuels	Not sure				
		Potential extent of deaths	0-4	Very low				
		Potential extent of injury	4-50	Low				
		Potential extent of damage or loss to critical infrastructure	Temporary relocation	Low				
		Potential extent of damage or loss to lifelines	Interuption of a few days	Low				
		Potential extent of property damage or loss	Localized damage, contaminated soil	Low				
		Potential extent of damage or loss to environment	Localized & severe	High				
		Potential extent of economic or social impact	Temporary impact	Very low				
Earthquake	**No records of large earthquake in this area. Fault lines are further out in ocean.**	**Vulnerable populations**	Elderly, children	Yes	Very high	Very rare event	Every 200-300 years	
		Vulnerable areas close to hazard	Schools, hospital, gov admin,	Yes				
		Inadequate alert or evac plans	Check with agencies	Not sure				
		Limited capability to respond or recover		Yes				
		Dated risk analysis, response recovery plans	> 10 years old	Yes				
		Inadequate hazard specific contingency plans	> 10 years old	Yes				
		Potential extent of deaths	4-10	Low				
		Potential extent of injury	4-50	Low				
		Potential extent of damage or loss to critical infrastructure	Loss of 50% capability	High				
		Potential extent of damage or loss to lifelines	Interuption of one week	High				

HAZARD		CONSEQUENCE				LIKELYHOOD		RISK PRIORITY
	Description	Vulnerability & Impact	Description	Assessment	Rank	Rating	Description	
		Potential extent of property damage or loss	Wide spread & severe	Very high				
		Potential extent of damage or loss to environment	Localized damage	Low				
		Potential extent of economic or social impact	Extended & widespread	High				
Fire - Interface & Wildfire	**Evidence of historical forest fires visible throughout valley.**	**Vulnerable populations**	Elderly and children	Yes	Very high	Occasional slight chance	Every 10 - 30 years	
		Vulnerable areas close to hazard		Yes				
		Inadequate alert or evac plans	10 years old, inadequate personnel to alert	Yes				
		Limited capability to respond or recover	BC Wildfire provides support but in	Yes				
		Dated risk analysis, response recovery plans	> 10 years old	Yes				
		Inadequate hazard specific contingency plans	> 10 years old	Yes				
		Potential extent of deaths	0 - 4	Very low				
		Potential extent of injury	4 - 50	Low				
		Potential extent of damage or loss to critical infrastructure	Loss of 50% capability	High				
		Potential extent of damage or loss to lifelines	Interuption of one week	High				
		Potential extent of property damage or loss	Localized & severe	High				
		Potential extent of damage or loss to environment	Wide spread & severe	Very high				
		Potential extent of economic or social impact	Extended & widespread	High				
Epidemic - Human	**Isolated community provides opportunity to control outside access in event of epidemic in outside world and also for quarantying.**	**Vulnerable populations**	Elderly, sick, children	Yes	High	Unlikely, improbable	Every 30 - 100 years	
		Vulnerable areas close to hazard	infrastructure not affected	No				
		Inadequate alert or evac plans	Check with hospital	Not sure				
		Limited capability to respond or recover		Yes				
		Dated risk analysis, response recovery plans	> 10 years old	Yes				
		Inadequate hazard specific contingency plans	> 10 years old	Yes				
		Potential extent of deaths	10 - 50	High				
		Potential extent of injury	50 - 2000	High				
		Potential extent of damage or loss to critical infrastructure	Loss of 50% of capability, hospital staff affected	High				
		Potential extent of damage or loss to lifelines	Interuption of a few days	Low				
		Potential extent of property damage or loss	Minimal damage	Very low				
		Potential extent of damage or loss to environment	Minimal damage	Very low				
		Potential extent of economic or social impact	Extended & widespread	High				
Explosion or Emissions	**Main issue is fuel storage at harbour, gas stations, airport; gas, diesel, propane**	**Vulnerable populations**	Harbour, Bella Coola, 4 Mile, Hagensborg	Yes	High	Highly unlikely, rare event	Every 100 - 200 years	
		Vulnerable areas close to hazard		Yes				
		Inadequate alert or evac plans	Columbia fuels, airport	Not sure				
		Limited capability to respond or recover		Yes				
		Dated risk analysis, response recovery plans	> 10 years old	Yes				
		Inadequate hazard specific contingency plans		Not sure				
		Potential extent of deaths	0-4	Very low				
		Potential extent of injury	4-50	Low				

HAZARD		CONSEQUENCE				LIKELYHOOD		RISK PRIORITY
	Description	Vulnerability & Impact	Description	Assessment	Rank	Rating	Description	
		Potential extent of damage or loss to critical infrastructure	Temporary relocation	Very low				
		Potential extent of damage or loss to lifelines	Interuption of a few days	Low				
		Potential extent of property damage or loss	Localized and severe	High				
		Potential extent of damage or loss to environment	Localized impact	Low				
		Potential extent of economic or social impact	Temporary impact	Very low				
Infrastructure Failure	**Extended electrical power, water and telephone are main concerns**	**Vulnerable populations**	Extended power outage will affect population	Yes	High	Moderate or likely	Every 3 - 10 years	
		Vulnerable areas close to hazard	Extended power outage can lead to freezing pipes, flooded basements	Yes				
		Inadequate alert or evac plans	BC Hydro, Telus have response plans	No				
		Limited capability to respond or recover	Resources are available locally	No				
		Dated risk analysis, response recovery plans		Not sure				
		Inadequate hazard specific contingency plans		No				
		Potential extent of deaths	0-4	Very low				
		Potential extent of injury	0-4	Very low				
		Potential extent of damage or loss to critical infrastructure	Closure of a few days	Low				
		Potential extent of damage or loss to lifelines	Interuption of one week	High				
		Potential extent of property damage or loss	Localized damage	Low				
		Potential extent of damage or loss to environment	Minimal damage	Very low				
		Potential extent of economic or social impact	Temporary impact	Very low				
Landslide or Debris Flow	**Potential land slides near steep areas and creeks with large transport potential, likely triggered by earthquake or storm event.**	**Vulnerable populations**	People live near moutains and on creek fans	Yes	High	Unlikely, improbable	Every 30 - 100 years	
		Vulnerable areas close to hazard	Structures are close to steep mountains and on creek fans	Yes				
		Inadequate alert or evac plans	No system to warn on slides	Yes				
		Limited capability to respond or recover	Equipment available locally	No				
		Dated risk analysis, response recovery plans		Yes				
		Inadequate hazard specific contingency plans		Yes				
		Potential extent of deaths	0-4	Very low				
		Potential extent of injury	4-50	Low				
		Potential extent of damage or loss to critical infrastructure	Not located in hazardous areas, temporary relocation	Very low				
		Potential extent of damage or loss to lifelines	Interuption of a few days	Low				
		Potential extent of property damage or loss	Localized damage	Low				
		Potential extent of damage or loss to environment	Localized and severe	High				
		Potential extent of economic or social impact	Temporary impact	Very low				
Severe Weather	**Hurricane force winds, ice storms, extreme cold outflows**	**Vulnerable populations**	Windfall injury	Yes				
		Vulnerable areas close to hazard	Whole valley is exposed	Yes				
		Inadequate alert or evac plans	Dated plans	Yes				
		Limited capability to respond or recover		Yes				

HAZARD		CONSEQUENCE				LIKELYHOOD		RISK PRIORITY
	Description	Vulnerability & Impact	Description	Assessment	Rank	Rating	Description	
		Dated risk analysis, response recovery plans		Yes	Very high	Unlikely, improbable	Every 30 - 100 years	
		Inadequate hazard specific contingency plans		Yes				
		Potential extent of deaths	0-4	Very low				
		Potential extent of injury	4 - 50	Low				
		Potential extent of damage or loss to critical infrastructure	Closure of a few days	Low				
		Potential extent of damage or loss to lifelines	Interuption of one week	High				
		Potential extent of property damage or loss	Widespread and severe	Very high				
		Potential extent of damage or loss to environment	Localized	Low				
		Potential extent of economic or social impact	Temporary and widespread	Low				
Transport Accident - Air	Regular sched flights ~ 20 passengers	Vulnerable populations	Passengers	Yes	High	Unlikely, improbable	Every 30 - 100 years	
		Vulnerable areas close to hazard		No				
		Inadequate alert or evac plans	Dated response plan	Yes				
		Limited capability to respond or recover	Limited ambulance, hospital service	Yes				
		Dated risk analysis, response recovery plans		Yes				
		Inadequate hazard specific contingency plans		Yes				
		Potential extent of deaths	10 - 50	High				
		Potential extent of injury	4 - 50	Low				
		Potential extent of damage or loss to critical infrastructure	Temporary interuption	Very low				
		Potential extent of damage or loss to lifelines	Temporary interuption	Very low				
		Potential extent of property damage or loss	Localized damage	Low				
		Potential extent of damage or loss to environment	Localized damage	Low				
		Potential extent of economic or social impact	Temporary impact	Very low				
Transport Accident - Road	Main concern is bus accident	Vulnerable populations	Passengers	Yes	Low	Occasional, slight chance	Every 10 -30 years	
		Vulnerable areas close to hazard		No				
		Inadequate alert or evac plans		Yes				
		Limited capability torespond or recover	Limited ambulance, hospital service	Yes				
		Dated risk analysis, response recovery plans		Yes				
		Inadequate hazard specific contingency plans		Yes				
		Potential extent of deaths	10 - 50	High				
		Potential extent of injury	4 - 50	Low				
		Potential extent of damage or loss to critical infrastructure	Temporary interuption	Very low				
		Potential extent of damage or loss to lifelines	Temporary interuption	Very low				
		Potential extent of property damage or loss	Localized damage	Low				
		Potential extent of damage or loss to environment	Localized damage	Low				
		Potential extent of economic or social impact	Temporary impact	Very low				
Transport Accident - Marine	Limited marine traffic, main concern is BC Ferry	Vulnerable populations	Passengers	Yes				
		Vulnerable areas close to hazard		No				
		Inadequate alert or evac plans		Yes				

HAZARD		CONSEQUENCE				LIKELYHOOD		RISK PRIORITY
	Description	Vulnerability & Impact	Description	Assessment	Rank	Rating	Description	
	or supply barge sinking	Limited capability toerespond or recover	Limited water emergency crafts	Yes	High	Unlikely, improbable	Every 30 - 100 years	
		Dated risk analysis, response recovery plans		Yes				
		Inadequate hazard specific contingency plans		Yes				
		Potential extent of deaths	4 - 10	Low				
		Potential extent of injury	4 - 50	Low				
		Potential extent of damage or loss to critical infrastructure	Temporary relocation	Very low				
		Potential extent of damage or loss to lifelines	Temporary relocation	Very low				
		Potential extent of property damage or loss		Low				
		Potential extent of damage or loss to environment	Localized and severe in case of fuel spill	High				
		Potential extent of economic or social impact	Temporary and widespread	Low				
Tsunami	Fiord system will buffer against tsunami originating in open ocean; inland tsunami from land slide could be more devastating.	Vulnerable populations	Bella Coola population	Yes	Very high	Highly unlikely, rare event	Every 100 - 200 years	
		Vulnerable areas close to hazard	Harbour & Bella Coola	Yes				
		Inadequate alert or evac plans	Outdated	Yes				
		Limited capability to respond or recover		Yes				
		Dated risk analysis, response recovery plans	Outdated	Yes				
		Inadequate hazard specific contingency plans	Outdated	Yes				
		Potential extent of deaths	4 - 10	Low				
		Potential extent of injury	4 - 50	Low				
		Potential extent of damage or loss to critical infrastructure	Permanent loss of hospital, school	Very high				
		Potential extent of damage or loss to lifelines	Interuption of a few days	Low				
		Potential extent of property damage or loss	Localized and severe	High				
		Potential extent of damage or loss to environment	Localized damage	Low				
		Potential extent of economic or social impact	Temporary but widespread	Low				